THE KENT INCORPORATED SOCIETY
FOR PROMOTING EXPERIMENTS IN
HORTICULTURE

ANNUAL REPORT

(SIXTEENTH YEAR)

1928

I. GENERAL

EAST MALLING RESEARCH STATION

1st January, 1928, to 31st December, 1928

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CONTENTS

SECTION I.

PAGE

GENERAL DEVELOPMENT AND ACTIVITIES 9

SECTION II.

THE FARM 25

SECTION III.

BRIEF PROGRESS REPORT OF INVESTIGATIONS AND SUMMARIES FOR FRUIT GROWERS 31

Part I. POMOLOGY.

Progress Report 35
Publications During the Year 41

Summaries for Fruit Growers:

"The Effects of Various Fruit Growing Practices on Fruit Quality and Market Value." R. G. HATTON 47
"Apple Pruning. Summary of Deductions from Experiments at East Malling." N. H. GRUBB 62
"The Effects of Potash Fertilisers on Apple Trees." N. H. GRUBB 70
"Red Currant Varieties." J. AMOS 73
"The Proposed Fruit Soils Survey in Kent." N. B. BAGENAL (K.E.C.), W. GOODWIN (S.E.A.C.) and R. G. HATTON .. 80

Part II. PHYSIOLOGY.

Progress Report 87
Publications During the Year 89

Part III. BIOCHEMISTRY.

Progress Report 93

Part IV. PLANT PATHOLOGY. MYCOLOGY AND BACTERIOLOGY.

PAGE

Progress Report 97
Publications During the Year 101

Part V. PLANT PATHOLOGY. ENTOMOLOGY.

Progress Report 109
Publications During the Year 111
Summaries for Fruit Growers :—
"The Fruit Tree Red Spider." A. M. MASSEE 116
"The Black Currant Gall Mite on Red Currants." A. M. MASSEE 123

Part VI. HOPS.

Progress Report 127
Publication During the Year 127

Part VII. METEOROLOGICAL OBSERVATIONS.

Weather Conditions During 1928 131
Summaries of Mean Temperature Rainfall and Sunshine from August, 1914, to December, 1928. H. M. TYDEMAN and H. C. CHAPELOW 134

RULES OF MEMBERSHIP AND LIST OF ASSOCIATE MEMBERS 142

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. V. TAYLOR, Esq., M.B.E., A.R.C.Sc.

STAFF.

Director: RONALD G. HATTON, M.A. (Oxon.).

Assistant Director: R. C. KNIGHT, D.Sc. (Lond.), D.I.C.

Pomology: R. G. HATTON.
N. H. GRUBB, M.S.A. (Cornell).
W. S. ROGERS, B.A., Dip. Hort. (Cantab.).
J. AMOS, N.D.H., *Manager* Recorder.
A. W. WITT, N.D.H., *Propagator* and Recorder.
H. M. TYDEMAN, Assistant Recorder, *Plant Breeding.*
Miss A. D. MACKENZIE, Dip. Hort. Sci. (Oxford and Reading), In charge of records.
A. C. PAINTER, Assessor of Market qualities.
Miss G. M. BLINKHORN, Assistant Recorder.
Miss M. GILLMAN, Hort. Dip. (Swanley), Assistant Recorder.
R. J. GARNER, Dip. Hort. Sci. (Reading), Assistant Recorder, *Propagation.*
F. H. BEARD, Hort. Dip. (Wye), Assistant Recorder, *Hops.*
W. APPLEYARD, B.A. (Cantab.), Assistant Recorder.
W. A. BANE, B.Sc.Hort. (Reading), Assistant Recorder.
D. H. HAMMOND, Assistant Recorder, *Propagation.*

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R. V. HARRIS, B.Sc. (Lond.), A.R.C.Sc., D.I.C.
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Guide Demonstrator and Exhibitions Officer: H. C. CHAPELOW, Meteorological Records.

Laboratory Assistants: C. CORNFORD, Miss I. D. SKINNER, Miss K. CORNFORD.
O. USMAR.

Horticultural Advisory Officer to Kent County Council stationed at East Malling:
N. B. BAGENAL, B.A. (Cantab.).

Secretary: Miss M. K. GLOVER, F.I.S.A.

Book-keeper: P. R. WOOD.

Shorthand Typists: Miss M. B. HOAD, Miss E. M. SHEPHERD, Mrs. E. D. HUGHES, Miss E. M. LAWSON.

VISITING DAYS

Visiting Days: Tuesdays and Fridays, or by special appointment.
Hours: 10-12 a.m. 1-5 p.m.

Passenger Station: East Malling Halt.

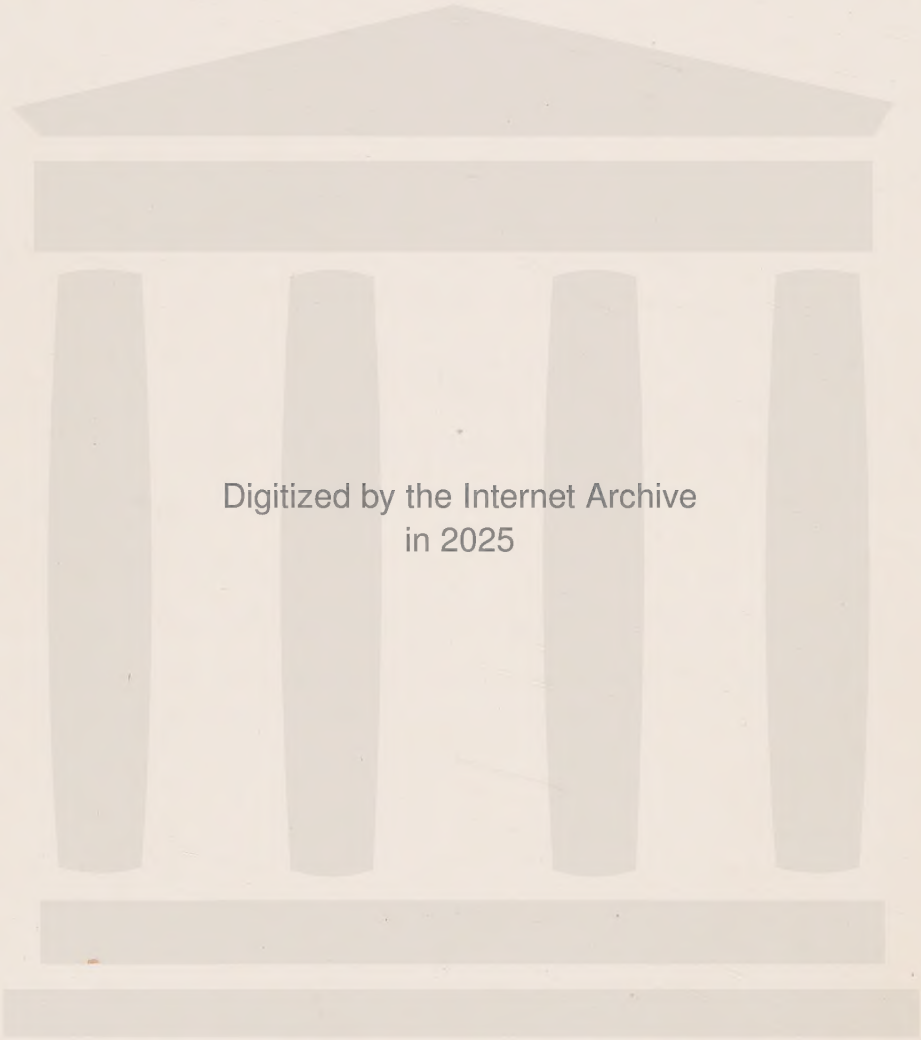
Goods Station: Aylesford.

Bus Services from Maidstone every twenty minutes to East Malling Church.

Ditton Corner, on the main London—Maidstone Road, is the turning to the Research Station for visitors coming by road.

Section I

General Development and Activities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Section I

GENERAL DEVELOPMENT AND ACTIVITIES.

1928 is the first full year in which we have enjoyed the advantages following the expansion of accommodation and the increase in Staff made possible by financial encouragement from various sources. The details of these extensions have been dealt with in previous reports but it is desirable to record that the increased facilities have resulted in considerable saving of effort both in the general direction of our activities and in the conduct of the work of every section concerned. The natural result is a feeling of confidence that even with the inevitable widening of scope, the standard of work has been maintained.

Whilst no further actual extension has taken place during the year, certain developments which were foreshadowed in the last report have progressed further towards realisation.

As a result of the invitation of the Empire Marketing Board, schemes have been considered in detail for the improvement of our capacity to satisfy the continual demand of post graduate workers for accommodation, and also for the means of assisting certain sections of our activities which are still in need of development.

Following a resolution of the Imperial Agricultural Research Conference in 1927, to establish Research Bureaux to effect closer *liaison* between home and overseas workers, we have been invited to consider the establishment of a Bureau of Fruit Production at East Malling in close association with the Station. In accepting the invitation we appreciate not only the compliment paid to our past work, but also the fact that the Station must inevitably reap the benefit of extended and more intimate contact with other workers in the same field.

A feature of the year, which is demonstrated by the facts detailed later in this report concerning the rapidly increasing number of visitors and enquiries which we receive from overseas, is that even before arrangements have materialised to enable us to deal satisfactorily with the calls, we already find it necessary to do much of the work without the adequate facilities.

It is pleasant to find in our records of visitors and advisory work that with the progressive increase in the number of our overseas correspondents and visitors, the number of contacts made with home growers is rapidly increasing, so that we feel confident that the Station is implementing its policy of continuing to discharge the debt which it owes to the Industry at home.

Committees.

The happy augury at the opening Committee of the year was the return of Mr. P. Manwaring to active participation in the Station's affairs. He was cordially welcomed by the Acting-Chairman, Mr. W. Rogers and the Committee.

Mr. Manwaring, after expressing his thanks to the Committee and his pleasure at again being with his friends at East Malling, asked Mr. Rogers to continue in the Chair until he had gathered together the threads of the ever-progressive work of the Research Station. Appreciating the work of Mr. Rogers in undertaking the onerous duties of Chairman during the absence of Mr. Manwaring, the Committee requested Mr. Rogers to consent to his appointment to the Vice-Chairmanship, to which he agreed.

Under the Articles of Association the following Members of the Committee retired automatically:

Mr. B. Champion, Sir M. Collett, Mr. W. Colthup, Mr. W. R. Elgar, Mr. O. Ellis, Mr. A. Hinge, Mr. T. W. Hubble, Mr. J. D. Maxted (also a Member of Executive), and Mr. C. J. Miller.

Our gratitude is due to these gentlemen for their services, and we welcome the following new Members to the Committee:—

Mr. S. S. Boorman, Mr. A. Day, Mr. B. R. Dixon, Mr. E. Hardy, Mr. T. T. Harlow, Mr. T. D. Harris, Hon. W. E. C. James, Mr. T. Neame and Mr. S. W. Mount (also to Executive).

The Committee welcomed the presence of Mr. H. V. Taylor of the Ministry, who attended (by invitation) all the Main and Executive Committees.

During the year the Executive Committee met three times, in addition to the Meetings of Sub-Committees.

The chief subjects under consideration were General Finance, extension and development schemes involved by the invitation of The Empire Marketing Board and East Malling Development Fund.

The Annual General Meeting.

The Eighth Ordinary General Meeting of the Society was held on the 16th May, 1928.

The Annual Report for the Fifteenth Year (1927) and the Balance Sheet for Year ending September 30th 1927, were presented and approved.

The second Annual Members' Gathering numbering about sixty, was addressed by Sir Daniel Hall and Mr. H. V. Taylor. We hope that the Ordinary General Meeting and Members' Day is proving a channel for creating personal contacts and increasing the interest of our Associate Members in the Research Work.

Finance.

The Maintenance Grants for the year 1st October 1927, to 30th September 1928, received from the Ministry of Agriculture totalled £8,323. 10s. 7d.

In addition special research grants were received from the Ministry amounting to £306. 8s. 11d. in respect of Special Investigation in Incidence and Control of Apple Scab and of the Fruit Soil Survey on the Greensand.

Maintenance Grant for the same period from the Empire Marketing Board amounted to £5,170.

The annual contributions of the County Councils of Kent, East and West Sussex are again gratefully acknowledged.

The United Potash Company have given us assistance amounting to £200 per annum in extending and intensifying our long period manurial trials recently inaugurated.

The total sales of produce amounted to £3,979 0s. 5d., a creditable showing in view of the heavy demands of experimental work on our crops.

Buildings and Land.

No building has been in progress during the year and no new acquisition of land has taken place, but as usual, all existing accommodation is taxed to the utmost.

Staff.

Very few changes in personnel have taken place during the year. It has been found possible to obtain the whole-time services of Mr. W. Steer, B.A., who for some time worked at the Station during his vacations and also for part of the period covered by his Ministry of Agriculture Scholarship.

Mr. W. Appleyard, B.A., came to the Station from Cambridge to take up work in connection with the Fruit Soil Survey, and pending opportunity for the intensive prosecution of this work has assisted with the new manurial trials and has gained experience in general recording.

After an association lasting three years, the recording staff has lost the services of Miss G. M. Blinkhorn and Miss M. Gillman, both of whom left, accompanied by the good wishes of all, on getting married. Mr. W. A. Bane, B.Sc. Hort. (Reading) is now assisting with the various aspects of recording.

We welcome Mr. D. Hammond on his return to the propagation staff after two years' experience at the Edinburgh Botanic Garden.

At the request of Dr. Rivett, of the Australian Council of Scientific and Industrial Research we found it possible to offer accommodation to Mr. G. B. Tindale, of Melbourne, who was associated with us for the greater part of the year. During his stay he found opportunity to visit several fruit areas in the country and obtained a general view of the research in progress at the Station,

in addition to gaining experience of the details of the technique of several of our trials.

Mr. L. J. D. Mackie, who has again visited the Station during vacations, Mr. A. J. Wooldridge, of the Agricultural Institute at Long Sutton, and Miss R. F. Stern, of Northampton, have assisted with recording work whilst obtaining an insight into the general lines of research.

Collaboration.

In May the Staff paid a two-day visit to the Long Ashton Station, during which the research programmes were discussed and arrangements made to maintain close contact in lines of work on which both Stations are directly engaged. Advantage was taken of the opportunity to visit the plantations and experimental plots, and on several occasions also during the year we have been pleased to see various members of the Long Ashton Staff at East Malling.

Close collaboration has also been continued with Professor Salmon and Mr. Ware, of Wye, in the work on new seedling hops.

We are again indebted to Mr. F. C. Arnaud for his co-operation in regard to manure analysis.

We have continued our close association with Mr. M. B. Crane in relation to the breeding of rootstocks and with Mr. F. T. Brooks in Silver Leaf experiments.

Mr. T. C. Thrupp, who frequently visited us when working at Wye, returned for a short period during the summer to continue his investigation on Mosaic disease of Hops.

We are in close association with Dr. Goodwin and Mr. Gethin Jones, of Wye, in the work on the Fruit Soils Survey, of which mention is made elsewhere, and Dr. Goodwin has continued his co-operation with the Entomological Section in dealing with insecticides.

The close collaboration with Professor Blackman and the Research Institute, Imperial College, is still maintained through the medium of Dr. Knight's continued association with the station.

Staff Meetings.

Owing to pressure of various circumstances, including much illness among the Staff, it was impossible to carry out the normal programme of Staff meetings, so that apart from meetings for purposes of general discussion only three papers were given, the average attendance being 27.

The programme for Session 1928-9 is more ambitious and includes a visit from Dr. H. E. Armstrong, F.R.S.

The Social and Athletic Club.

The Social and Athletic Club has continued to prosper throughout 1928. The membership has steadily increased with the increase in Staff, and reached

a total of ninety eight at the end of the year, an increase of sixteen on the 1927 total. Activities of a social nature included such diversities as country dancing and meetings of the literary circle, the most notable events being, undoubtedly, the summer outing to Folkestone and the Christmas Supper and Concert.

The athletic proclivities of members have also not been neglected. Eight cricket matches were played against local teams, and one of the most popular events of the year was a match played *versus* an eleven captained by the Chairman of the Executive Committee. Two football matches were also played against local teams, indicating clearly that the nucleus for a regular football team exists. The handicap to organising such a team is the fact mentioned in a previous report in connection with cricket, that at present the Club does not possess an athletic ground.

The membership of the tennis section has increased, due no doubt to improved weather conditions, and the hard court has been well used.

During the season a tournament was organised for the first time and was well supported.

Fruit Soils Survey in Kent.

Preliminary work has commenced on this Survey by Dr. Goodwin and Mr. Jones, of Wye, and the Staff of the Station. Round-table conferences and short tours of the Greensand area are enabling us to develop a technique suited to the particular problems which are arising.

Further excavations of root systems continue to give valuable indications of the relative importance of the various factors concerned and a beginning has been made with the more intensive survey of the area. The account given on p. 80 indicates the general method of procedure which has been adopted.

The Journal of Pomology and Horticultural Science.

The editorial work of this Journal has again been undertaken by the Station, and has involved attendance at meetings of the Editorial Committee in London in addition to the usual office work.

The Station's Publications.

Besides the production of Part I., General of the Annual Report for 1927, a supplement of 170 pages was issued dealing in more detail with the work of the two-year period 1926-27. In all, forty papers were published during 1928, summaries of which will be found following the Sectional reports in this volume.

It is worthy of note that there is an increasing demand for our publications, many of which are already out of print.

For some years with Mr. Bagenal's editorial assistance we have contributed each month short articles to the Journal of the Kent Branch of the N.F.U. These take the form of practical notes for fruit-growers on subjects appropriate to the season, a list of which is appended.

1928.	January.	Excavations at E.M.R.S.
		Cold Weather—effect on Insect Pests.
	April.	Red Spider on Apples.
		Aphis on Apples.
		Formula for Grafting Wax.
	May.	Strawberry Trials.
		Red Spider on Apples—Post-blossom Spraying.
		Apple Sawfly.
		Raspberry and Loganberry Bud Moth.
		Raspberry Cane Midge.
		Raspberry Cane Spot—Pre-blossom Spraying.
		Apple Scab and Mildew.
	June.	Roguing Black Currants for Reversion.
	July.	E.M.R.S. Exhibit at Folkestone.
	August.	Beneficial Effect of Potash on Apple Trees.
		Autumn and Spring Planting of Strawberries.
		Capsid Bugs.
	September.	Have you seen our Potash Experiments ?
		Tree-Planting Notes—Apples and Plums.
	October.	Tar Distillate Washes.
		Control of Raspberry Diseases.

Outside Trials.

The time spent in recording on experimental plots established outside the Station has again been inevitably limited, but the recording Staff spent a day pruning at Mr. A. J. Carter's farm at Wisborough Green, and the usual attention was also given to the plot at Swanley. The stock trial at Wisley is completed and the trees are being used for the purpose of following root range in detail by the process of piecemeal excavation which is further referred to later.

Advisory Work.

Correspondence.

The year has seen a further increase in the advisory work done through the post, the total number of queries dealt with being 1,218 compared with 1,028 for 1927. The greatest increase appears in the groups relating to fungus and insect troubles, but it is evident that much of the time of the whole Staff is

devoted to fulfilment of the advisory function, for which it is hoped that some provision may soon be made.

An analysis of the nature of the queries will serve to show their relationship to certain aspects of the Station's work, the increasing interest in rootstocks being worthy of note.

Pomology.		
Small Fruits	78	
Fruit Tree Rootstocks	265	
Propagation	75	
Planning and Planting	63	
General Spraying	37	
Pruning	17	
Manuring	65	
Walnuts	34	
Miscellaneous	154	
		788
Pathology.		
Mycology and Bacteriology :—		
Raspberry Diseases	50	
Logan- and Blackberry Diseases	12	
Hop Diseases	19	
Scab, Mildew and Canker	32	
Spray Injury	6	
Dieback of Plums and Cherries	20	
Crown Gall, Brown Rot, Silver Leaf, etc.	36	
Miscellaneous	38	
		213
Entomology :—		
Gall Mites	36	
Red Spiders	14	
Coleoptera (Mainly Weevils)	20	
Aphides (Mainly Woolly Aphis)	22	
Capsids	24	
Insecticides	43	
Lepidoptera	8	
Apple Sawfly	6	
Raspberry Beetle	5	
Miscellaneous	39	
		217
Total		1,218

Enquiries from Kent (418) naturally outnumbered those from other parts of the country, whilst Sussex claims 97, Surrey, Middlesex, Essex and Hants 40 to 50 each, and 50 letters from Scotland, Ireland and Wales appear in the totals. Over forty counties are represented and in addition 47 queries from the Overseas Empire were dealt with as well as 21 from foreign countries. Of the Overseas totals 41 concerned rootstocks, and were largely related to experimental work at the place of origin.

In this work close co-operation with Mr. Bagenal is maintained and 30 additional queries of a general nature were referred to him to be dealt with, whilst he in turn referred letters to us for detailed treatment.

Visits.

Advisory work by means of personal visits to plantations has again been regularly carried out. In all 153 visits were paid during the year, the majority of which were in Kent and Sussex, whilst a short tour of some fruit areas in Yorkshire and Notts. was undertaken by two members of Staff, in the course of which some seven visits were paid. Two days were also spent in a rapid general survey of a portion of the Greensand area when, under Mr. Bagenal's guidance, it was possible to construct the itinerary for the return visit during the intensive study of the area.

Three districts were visited to obtain further information with regard to distribution and performance of the Red Currant varieties in connection with our work of classification.

Roguing operations in Black Currant plantations have been fewer than during 1927, but as the result of requests of our Members eight days were spent in rendering this service on six different plantations and detailed reports were sent to each of the growers concerned.

Several days were again spent in judging at shows and in farm competitions throughout the county.

In the course of the year Mr. Bagenal paid 182 visits to Kent growers, many of which resulted from queries addressed to the Station. Mutual advantage continues to accrue from the close co-operation between Mr. Bagenal and the Station Staff.

During June two members of Staff made a tour of fruit areas in Holland and the Rhineland lasting about ten days. The main objects of the tour were to study at first hand the details of the methods and conditions of propagation of rootstocks in Holland and to obtain information as to the distribution and performance of dwarfing apple rootstocks in the fruit areas along the lower Rhine. Great benefit was derived from the interchange of opinions and experience with many growers with whom we had previously been in postal

communication and much information was obtained on the general problem of rootstocks.

A number of workers (including some from Australia, South Africa, Malaya, Kenya, and the Gold Coast) interested in plot layout, have paid visits to the Station in order to discuss with the Pomological and Statistical Sections the applications of the technique now in use at the Station, to their own particular problems.

Four horticultural field trials have been planned and in addition considerable assistance has been given by the Statistical Section during the year to the research staff of a large commercial undertaking in the analysis of the results from their field trials.

Lectures, Demonstrations, Conferences.

Lectures.

This year thirty-one lectures were given in various parts of the country, chiefly in the South-Eastern area but including one on Growers' Day at the Imperial Fruit Show at Manchester. The subjects included General Pomology, Pruning, Fruit Marketing and Strawberry Culture, whilst the majority dealt with Pathological questions.

Demonstrations.

In June several hundreds of Hop growers assembled at the Station on the occasion of a demonstration of the mixing of Bordeaux Mixture. Dr. Goodwin, of Wye, Mr. Bagenal and Mr. Amos, gave half-hourly demonstrations of the actual processes and Professor Salmon afterwards addressed the assembly on the "Methods of Control of Downy Mildew." A fortnight later Professor Salmon and Dr. Goodwin also assisted at a demonstration of Hop Washing Machines fitted with nozzles suitable for the application of Bordeaux Mixture to Hops. The machines were supplied by Messrs. Weeks & Son and Messrs. Drake and Fletcher, and 150 growers attended.

Mr. Witt gave demonstrations in grafting and budding on ten occasions and on about forty other days our visitors were shown the details of general propagation work.

Conferences.

The Inspectors of the Ministry of Agriculture who are particularly concerned with reversion and varieties of Black Currants found opportunity to repeat their visit of 1927 in order to study the details of the subject still further. We welcomed discussions which took place during their two days' stay.

This year also a party of Horticultural Inspectors from the Eastern Counties spent two days in a general tour of the plantations, and it is pleasing to note

that individuals now have no hesitation in searching out particular plots or members of Staff concerned with subjects in which they are specially interested.

The usual demonstrations and short lectures have been given from time to time in the Laboratories on the occasions of visits of parties to the Station, and we are still finding it extremely valuable at times to follow the tour of the plantations with a conference, when very helpful discussions invariably take place.

In November the Provincial Conference of Horticultural Advisory and Research Workers of the South-Eastern Area, of which Mr. Bagenal is convener, held a day's Session at the Station. Twenty-five members attended and in the morning under the guidance of Mr. Grubb and Mr. Amos visits were paid to the plots devoted to experiments on pruning apples and plums. After lunch an interesting discussion followed the accounts given by Professor Theobald, Wye, and Mr. Costin, W. Sussex, of experiments in the control of Capsids.

The Station has been represented by Members of Staff on a large number of committees during the year including The Agricultural Research Council, International Horticultural Congress, Horticultural Advisory Council, Fruit Soils Survey Sub-Committee, Walnut Sub-Committee of the Royal Horticultural Society, Horticultural Educational Association, Virus Disease Sub-Committee and also at the Provincial Meeting at Wye of the Research and Advisory Officers of the South-Eastern Area.

EXHIBITS.

During the past year a new departure was made in the methods of arranging exhibits.

The exceptionally heavy calls upon the time of the members of staff concerned, entailed by the unusually large numbers of parties and visitors entertained at the Station, rendered necessary either some curtailment in the number of shows attended, or, alternately, a considerable simplification in the methods of preparing such exhibits.

In the past it had been usual to prepare a particular exhibit suited, as far as possible, to the special interests of each district visited. It will be readily seen that such a procedure involved a considerable expenditure of both time and money at the busiest season of the year, in the actual collection and valuation of the results of research and in their preparation for the exhibition stand.

With these facts in mind it was decided during 1928 to prepare a single exhibit for use at all shows visited. The subject selected for treatment—the contribution of rootstocks, pruning, manuring, thinning, spraying, etc., towards the improvement of the quality of apples—was felt to be of particular value at the present time. An exhibit bringing up to date the results of our researches was therefore prepared and when it was not being shown at various centres, was permanently upon view in the Exhibition Room at the Station.

In March the Ministry of Agriculture gave a demonstration at Maidstone bearing upon questions of fruit marketing at which our exhibit was staged, and three members of staff accompanied it. Following this, the Annual Spring Show of the Royal Horticultural Society at Chelsea was visited, when four members of staff were in attendance. A special invitation was received from the Royal Counties Show authorities to stage an exhibit at their annual show, when three members of staff attended a much appreciated exhibit at Reigate. As in previous years, the Sussex County Show and the Kent County Show were visited at Horsham and Folkestone respectively. Following the unfortunate circumstances which caused the cancellation of the Tunbridge Wells Agricultural Show in 1927, it is gratifying to be able to state that an exhibit was contributed in 1928.

At the second annual Autumn Show of the Ash and District Growers, our exhibit aroused considerable interest, and as an opportunity of reaching an audience mainly interested in small gardens, we welcomed the invitation of the East Kent Women's Institutes to exhibit at their Annual Show at Canterbury.

VISITORS.

The figures for the past year show a large increase over the high total for 1927 in the number of visitors to the Station. The number of organised parties—twenty-two, was the same as in 1927, three of these being exceptionally large and requiring the help of most of the members of the Staff.

Recorded Visitors, 1928.

Month.	No. of days on which visits were paid.	No. of visitors per month.
January	14	38
February	16	67
March	20	83
April	16	52
May	20	145
June	20	620
July	24	173
August	23	106
September	26	223
October	26	103
November	19	70
December	12	18
Total	236	1,708

Individual visits have been paid on 236 days, a considerable increase over the total of 207 last year.

This year, despite the fact that there was no session of the Imperial Agricultural Research Conference in London (as in 1927), we received visitors from the Overseas Empire, comprising representatives from eleven dominions, colonies, etc., on seventy-three occasions, whilst about fifty foreign enquirers from fourteen countries also came to the Station to make personal contacts.

Amongst those we welcomed were the party of Dominion Farmers touring this country, and in July a party of Growers from Germany. Also in this month we were glad to see the Staff of Messrs. Clarke's Nurseries, Dover.

We entertained in June some of the Horticultural Inspectors of the Ministry of Agriculture for a two day visit, and in July the Horticultural Superintendents from the Eastern Counties Province arranged a whole day visit.

In the same month the Walderslade Branch of the N.F.U. were our guests.

As in other years, parties of students from the Royal College of Science, Swanley Horticultural College, the S.E.A. College, Wye, and Reading University again found opportunity to study the Station's work in the plantations and laboratories.

Amongst other visitors were the London School Gardening Association, Members of the Snodland Branch of the Workers' Educational Association, and two parties of School Children from East Malling.

Library.

The increase in the number of periodicals and books available has been much appreciated during the year and the records show that 130 books and 387 periodicals, bulletins, etc., were taken out on loan. In addition use has been made of other libraries which have granted us facilities.

We are again indebted to a number of donors who have supplied us with various books and periodicals. Our thanks are due to the following:

L. C. Bushby, Esq.
The late Thomas Jamieson, Esq.
N. B. Bagenal, Esq.
Professor U. P. Hedrick.
Howard Spence, Esq.
H. R. Beeton, Esq.
A. M. Massee, Esq.
T. C. Thrupp, Esq.
The Editor, "Citrus Grower." (South Africa).
Nederland Pomological Society.
Messrs. Nitram, Ltd.

MEMBERSHIP SCHEME.

The Income from this Scheme during the year 1928 amounted to £391 6s. 6d., together with £16 7s. 7d. interest.

New Members :

3 Associate Members Life "Founders."
1 Associate Member Annual "Founders."
2 Associate Members Life "Fellows."
5 Associate Members Annual "Fellows."
6 Associate Members Life "Associates."
39 Associate Members Annual "Associates."

Eleven Annual Associates have notified their desire to have their names removed from the list.

ENDOWMENT FUND.

Progress has been made with the preparations for launching an appeal for this fund. Sir Bernard Greenwell, General Sir Ivor Maxse and Viscount Wolmer, M.P., have kindly consented to act as Trustees of the fund and to render assistance during its collection. We greatly appreciate their enthusiastic interest in the Station's affairs, of which their action is such a practical proof.

We have been fortunate in obtaining the consent of Mr. M. J. R. Dunstan, M.A., formerly Principal of Wye College, to assist us in issuing the appeal. It was due to Mr. Dunstan's initiative and foresight whilst at Wye that the Station was established, and he has always maintained his interest in its progress. It is therefore particularly appropriate that, residing now in the district, he finds himself able to spare the time to devote to our affairs. It is hoped that the appeal will be issued early in 1929.

ADMINISTRATIVE WORK.

The development of every section of Research automatically adds its quota to the administrative section.

The varied work may be summarised to some extent :—

MSS. typed for Publication	42
Letters, Post Cards, Notices, Bulletins	10,514
Parcels	231
Accounts, Receipts, Subscriptions, ...	1,004
Telephone, including Extensions	6,132
Stencils cut	93

The Membership Scheme is now firmly established and the annual work involved is on a routine basis.

A large amount of work including much stencil cutting and reproduction has been involved during the preparations, which we hope will be completed early in 1929, for launching the Endowment Fund Appeal.

The office work for the Library and Mailing Sections continues to increase, whilst the work entailed in distribution of stocks, especially with regard to shipments, has been unusually heavy.

The issue of stores (stationery, etc.) during the year was approximately double the amount in previous years, and consumed much of the time of the junior office staff.

The reception and entertainment of visitors again calls for emphasis, the year 1928 proving a record for the number to whom hospitality was extended. This section of the work is necessary, as no facilities are available in the locality.

The Secretary is very grateful for all the help accorded by the Administrative Staff.

Section II

The Farm

Section II

THE FARM

During the past year our mature apple-trees, comprising some twelve varieties, produced good average yields of fruit, thus giving us the opportunity of grading and marketing in bulk. The majority of the fruit was of excellent quality and practically the whole was marketed under the National Mark Scheme. Our crop of Bramley's Seedling was outstanding as regards size and finish of the fruits and this was particularly emphasised on those trees worked on the dwarfing stock, Jaune de Metz, No. IX. Worcesters also yielded a satisfactory crop.

Two of the factors which undoubtedly contributed much towards this level of attainment were spraying, and the thinning of the young fruits. A Tar Distillate wash was applied in January and was followed later by three fungicide sprays, viz., pre-blossom, Lime Sulphur (1 : 29), post-blossom Lime Sulphur (1 : 99), and in June with Colloidal Sulphur (4 : 100). These sprayings kept the trees remarkably free from Aphis and Scab throughout the whole season.

Thinning of the fruit was carried out (where possible) during June. Owing to the difficulty of arriving at a method which would not interfere with various other experiments in progress, thinning was almost entirely confined to Bramleys, Worcesters and Lanes. In the case of the first two, each truss was reduced to a single fruit, whilst it was possible with Lane's to experiment on the best distances at which to thin the fruits and also the relative merits of severe and light thinning. The trials will be repeated where possible next year (see p. 38).

For the first time we were able to harvest, in quantity, fruit from many of the Apples growing on our variety plot. These included such varieties as Orleans Reinette, Ribston Pippin, Heusgen's Golden Reinette, Upton Pyne, St. Everard and Roundway Magnum Bonum. In addition, several of the American varieties also fruited heavily, namely Grimes Golden, Ontario, Wagener, Winter Banana, Hubbardston Nonsuch and Mackintosh Red. The fruits of this latter group were particularly well matured and of excellent colour and finish.

The quantity of Apples produced this season has again given us the opportunity of using the "Cutler Grader" (made available by arrangement with Dr. West, of Cambridge) on a commercial scale, and this provided valuable experience in packing and grading as well as helping considerably in the recording of crops.

Satisfactory prices were realised, the comparatively high returns for the smaller grade fruit being in marked contrast to the previous year.

For the third year in succession, frosts and cold winds during blossoming were responsible for the complete failure of the Pear crop.

The Plum crop was somewhat variable, only one variety, viz., Myrobolan (Cherry Plum) carrying a full and what proved to be a highly remunerative crop. Whilst the varieties Victoria, Purple Egg, Giant Prune and Warwickshire Drooper carried a fair crop, varieties like Czar, Rivers' Early Prolific, Belle de Louvain and Denniston's Gage were almost a complete failure.

In the case of the Victoria, the fruit was thinned out in mid-July, being spaced about 1½ ins. apart, with the result that a good sample of fruit was obtained, the majority of which was suitable for marketing in punnets and 12 lb. chips, whilst the thinnings were sold satisfactorily in half-sieves. Prices obtained were good throughout.

The drought and excessive heat during July diminished what promised to be a record crop of Raspberries and in consequence the picking season was short.

The ten acres of Lloyd George and Pyne's Royal on Newgates Field were permanently wired and the whole area divided into ninety-six plots for manurial field trials. They received their first dressings in the early part of the year (see p. 39). This area yielded a considerable quantity of fruit and enabled us again to test various packages and the different ways of presenting the fruit to the market.

In previous reports we have always been able to record a satisfactory and paying crop of Black Currants. Unfortunately this season we have to chronicle an almost complete failure of this fruit. There is little doubt that frost and more particularly severe winds during blossoming was responsible for this catastrophe.

The only bushes which carried any appreciable crop were some new seedling varieties, raised by Capt. Wellington in 1913. These have now been under trial since that time, and have recently been propagated in quantity. The six acres of Baldwin Blacks on the Newgates Field have been divided into sixty-four plots and are being used for manurial field trials (see p. 39).

Morello Cherries, which blossomed profusely, also failed owing to frost damage.

The collection of large fruited varieties of dessert Gooseberries and also Red Currants both carried satisfactory crops.

Fresh plantings of fruit during the year include two acres of Royal Sovereign Strawberries, consisting of plants raised at the Station from strictly rogued parents of the previous year's planting.

Six acres of Church Field have been planted up with Standard Plums and Cherries. The Plums include Czar on vegetatively raised selections of St. Julien and also Warwickshire Drooper, Pershore and Bastard Victoria on their own roots, with trees worked on Myrobolan B and Common Mussel to act as controls.

Three varieties of Cherries are included, viz., Early Rivers, Napoleon, and Bigarreau Schrecken, all worked upon selected vegetatively raised Cherry stocks.

Two acres have been interplanted with Black Currants and include three varieties raised at Wisley and sent out for further trial, viz., Baldwin, Taylor's and Davison's Eight. A considerable number of our new seedlings have also been planted, together with representatives of the four main groups as controls.

The four acre piece on Church Field being prepared for the Apple manurial trials again carried a crop of Spring Oats which was harvested and weighed in one-fiftieth acre plots.

Practically the whole of the eight acres set aside on the Newgates Field for the extension of stool beds has been planted up with material comprising the most promising of our fruit tree stocks. These stocks have all made strong healthy growth and should shortly provide the foundation for the supply of first-class material in bulk.

During the past year some of our bushes of Black and Red Currants have been seriously damaged by a species of Capsid bug (*Lygus pabulinus*) and in two cases young trees of apple and pear have also suffered, but to a lesser degree. Efforts made to control the pest did not meet with much success. Much more stringent methods will be employed during the coming season in order to try and eradicate this most serious pest.

During the early part of the year Hops caused a great deal of anxiety. The prevalence of the " spike " form of Downy Mildew, coupled with unfavourable growing conditions, caused both a shortage and weakness of bine. It was only towards the end of the year that conditions favoured growth, but this occurred too late for full " head " and " branch " development and resulted generally in a light crop from most varieties.

Despite the early attack of Downy Mildew no infection of the cones took place. The dry and sunny weather during July and August proving (very fortunately) unfavourable to the spread of the disease.

Several rows of Hops were sprayed with Bordeaux Mixture at intervals throughout the season to test the effect, if any, on the plant and also as a protection against the spores of Downy Mildew. Whilst the earlier sprayings showed scorching of the young leaves, the later spraying did not have this effect.

Several rows of inferior varieties have been grubbed and an additional one and a half acres planted. The new plantings include an extended trial of some twelve varieties, raised by Professor Salmon, which have already been tested over a period of years, and are now planted in sixty hill plots in order to give a sufficient quantity for large scale brewing trials. A portion of the plot is also devoted to the variety L21, which has been planted in order to test hill distances and various methods of training.

Section III

Brief Progress Report of Investigations and Summaries for Fruit Growers

Part I

Pomology

Part I

POMOLOGY.

(a.) In Relation to Tree Fruits.

ROOT STOCK INVESTIGATIONS.

1. Stocks for Apples.

As the experimental plantations approach maturity, it becomes more difficult each year to maintain the intensive recording of individual tree measurements, but it is being continued upon a sufficient number of trees to provide data adequate for statistical treatment. The influence of different rootstocks upon the scion does not appear to be obliterated as the trees age, but as the crops increase the effect becomes more apparent upon the fruiting qualities. The trees on Jaune de Metz Stock (No. IX), after continuously heavy cropping, show no signs of early senescence and during a tour of investigation undertaken on the Continent flourishing plantations of twenty years' old and over upon this stock were observed.

2. Stocks for Pears.

A full report of the effect of various Quince rootstocks upon some eight commercial varieties of Pear is now published.

The nursery trials with vegetatively raised free Pear Stocks have now been repeated in three successive seasons and the trees closely observed during the first two years development. The manifestations of suitable and incompatible selections and combinations have been repeated with remarkable precision, and it has been possible to discard certain races with confidence and to multiply others more rapidly. In the young plantation of Dr. Jules Guyot on these new selections significant differences are already apparent between the early blossoming propensities of the trees on various selected free pear root systems.

3. Stocks for Plums.

A full report has been published, the Summary of which is given in the list of publications.

Two new field trials have been established during the year, one of a series of plum varieties upon their own roots and upon different dwarfing and vigorous root stocks; the other to test upon Czar—(a variety which readily shows preferences)—the suitability of some of our more recently selected rootstocks. These are the first trials with tree fruits to be arranged in a system of randomised blocks, the technique being slightly modified to suit horticultural requirements.

4. Stocks for Cherries.

Sweet Cherries (*P. Avium*).

Observations in the nursery on trees up to three years of age indicate that the various layered rootstocks under trial show considerably different influences on the growth and behaviour of the trees. It already seems probable that different scion varieties will show different stock preferences.

Analysis of Rootstock Influence and the Reciprocal Effect of Scion upon Root.

The third attempt to obtain a really representative series of scions grafted directly upon piece roots of different varieties of rootstocks together with a parallel series grafted, according to normal European custom, upon the stem, has provided a good series of trees for comparative trial. These should help to elucidate the theoretical question as to whether rootstock influence resides to a small degree, in the main, or entirely, in the stock stem as distinct from the stock roots, and the examination of the root characters of these trees when lifted should shed further light upon the reciprocal effect of scion upon root character.

The lifting of ten year old trees of Lane's Prince Albert (referred to below) for the purpose of obtaining data upon the character, depth, etc., of developed root systems of grafted trees of the same variety upon different stocks fully confirms the results of our analyses on young trees and show that the root characters persist quite distinctively in later life.

Root Excavation.

The root systems of six ten year old trees of Lane's Prince Albert, three on Stock No. I (Broadleaf) and three on No. IX (Metz), were excavated in the winter of 1927-8. Although the work involved in lifting these mature trees has been considerable, the results have been so striking that further excavations are being carried out during the present winter, 1928-9.

A progress report has been issued, a summary of which appears on p. 44. In view of the initiation of a fruit soil survey in Kent, this work was designed to afford a standard of comparison of the behaviour of tree roots on the Lower Greensand formation.

One of the excavated trees, a Lane's Prince Albert on Stock No. IX, has been hung in the hall of the new building, with its root system re-constructed in its original relative position. The roots of this dwarf tree extending to more than 9 feet below the original ground level, form a striking exhibit.

Pruning Experiments.

Apples.

Ten years' individual tree records are now available from the apple pruning plot. Although the trees are in many cases so variable that the "standard

error " is very large, the many repetitions of the various pruning treatments on different sets of trees and different varieties leave no room for doubt that the more noticeable effects of pruning, such as those on growth and cropping, are significant. A report or series of reports on various aspects of the work will go forward for publication shortly, and a revised summary of the deductions from pruning experiments appears below.

Pears.

The very definite effects of applying different pruning methods to young pears on quince was once again apparent, and a report on the behaviour of these trees has been published.

Manuring of Apples.

Potash.

A report has been now been published on the " Effect of Potash Fertilisers on Apple Trees," which has been under investigation for some years, and a summary of this is given in the list of publications. A discussion of the subject also appears on p. 70.

General.

After the inconclusive results which have so frequently been obtained from protracted applications of manures to Apple trees (especially with trees upon seedling rootstocks), the very striking differences in foliage, between our eight year old trees on various known rootstocks that were apparent on the manured and unmanured areas last season is encouraging.

An examination of the wood growth and girth measurements from year to year now shows definitely that the trees on the unmanured ground on nearly every rootstock are falling behind the manured series, though the former were slightly more vigorous before the treatment began. In the early years, there was no significant difference in growth between the trees on the manured and unmanured ground, and the difference now apparent would seem to coincide with the beginning of cropping of the trees, thus suggesting the time when judicious manuring becomes desirable. Contrary to expectation, the unmanured plot has not produced earlier crops, but it seems likely that detailed examination of the fruit records will reveal an effect on size and colour of fruit.

It is very satisfactory to have detected these results and those chronicled in the publication relating to the value of potash applications just when the land and material has become available for the laying out of our more exhaustive field trials. These have been designed to test amongst other things whether the requirements are identical for the same variety upon different rootstocks.

FRUIT THINNING.

Apples.

A thinning experiment was carried out on sets of :—

(*a*) 8 year old unpruned Worcesters.

(*b*) 9 year old unpruned Lane's.

(*c*) 9 year old pruned Lane's.

with the immediate object of ascertaining the effect of thinning on size and general quality of the fruit.

Whilst the figures appear to show that the results in the case of the Worcesters were inconclusive, the lightly thinned Lane's showed a definite response to the treatment in comparison with the heavily thinned and control trees.

It appears that response to thinning varies with variety, stock and pruning, and further trials will be carried out in this connection next season.

(b.) In Relation to Bush Fruits.

BLACK CURRANTS.

A new variety trial plot, consisting of 96 bushes each of four varieties, in units of four all supplied from a single source, has been planted contemporaneously at Long Ashton, R.H.S. Gardens, Wisley and East Malling for the purpose of collecting figures of comparative crop weights to see how far it is possible to establish an agreed technique for such trials. The form of trial used here is the "Latin Square."

A further extensive planting of Mr. R. Wellington's Baldwin-Boskoop crosses, from which three $\frac{H97,}{9}$ $\frac{H97,}{7}$ $\frac{H101,}{1}$ have been selected after protracted trial, has been made for comparison with clone bushes of the four main groups. The older bushes of these new introductions again cropped comparatively heavily in 1928, which was a very disadvantageous currant season.

RED CURRANTS.

The methods of identifying the main groups of Red Currants from vegetative characters in the nursery row, having stood another season's test, was issued to growers in the form of a key which is reprinted in this report.

In another year, sufficiently large clone races of the most important varieties should be available for laying out an extensive cropping trial. The original collections cropped fairly well during the year, and afforded further evidence of the value of Skinner's Early, Scotch and Utrecht.

The cropping of some varieties, such as Perfection, was reduced by frost and that of others, including La Constante, was reduced owing to attacks of a Currant Mite. Remedial measures against the latter will be carried out during the coming season.

STRAWBERRIES.

The three acres of Royal Sovereign strawberries planted in October, 1927, and March, 1928, were de-blossomed and drastically rogued with a view to producing good and comparable runners for future experiments.

From the records taken it appears that of the three " strains " compared, one is undoubtedly more free from " red plant " than the other two. The number of vigorous healthy plants resulting from the October planting was significantly greater than that from the March planting, and the amount of blossom produced was definitely greater on the October plants than on the March plants.

A new experiment has been laid out with comparable runners obtained from the first experiment mentioned above to test different " strains " and " times of planting."

A trial of uniformity of plant performance has also been planted to determine the size of unit required to obtain significant results.

MANURIAL TRIALS OF SMALL FRUITS.

Black Currants.

Two earlier series of field trials in Black Currant Manuring have indicated that, under our conditions, comparatively heavy dressings of nitrogen are the all important factor and the problem which presents itself would appear to be mainly a quantitative one. The optimum time of application is also to be considered.

Five acres of Baldwins have been divided into plots of 210 bushes each, and subjected to six different manurial treatments, each of which is repeated six times over the area.

Raspberries.

Seven and a half acres of young raspberries have also been subjected for the first time to different manurial treatments. In this case the variety Pyne's Royal has been chosen as a good medium through which to study the response of cane growth and increment, and subsequent cropping; to differences in quantity and form of nitrogen applications, in the presence and absence of potash.

The variety Lloyd George, on the other hand, presents a very different problem, in that heavy nitrogenous feeding is not necessary to produce good cane growth, and therefore in this case attention is being mainly concentrated upon non-nitrogenous artificial fertilisers.

The first year's applications have been made and records have been taken of crop weights and cane growth.

(c.) Fruit Breeding.

APPLES.

As a preliminary to further more extensive work, a few crosses were made during the past season between varieties of rootstocks, with the object of

producing seedlings capable of inducing intermediate vigour and precocity in the scion. A number of crosses between commercial varieties of widely differing season of ripening were also made in an effort to obtain seedlings of economic value covering as wide a range of season as possible. Material has been collected during the year for a study of the mode of inheritance of certain qualitative characters in the apple such as fruit colour and shape, and it is hoped to make a commencement with this work during the coming season.

Small Fruits.

A large number of black currant seedlings showing promise have been back-crossed on to one or other of the parent varieties during the past two years and a large number of the progeny of such crosses have been planted out in the field. A number of individuals, the result of crossings between the black and the red currant, have been raised, and the possibilities of such inter-species crosses are being explored. Investigations over several years under field conditions and amongst material crossed in the open, has brought to light a considerable fund of important data upon the genetics of *Ribes nigrum*. While three of the four chief groups of varieties of black currants appear to breed fairly true to the type when selfed, fundamental genetical differences in the selfed offspring of morphologically similar varieties within the French group have been brought to light and have been the object of considerable study. This part of the work is considered of sufficient importance to justify repetition under more closely controlled conditions.

Selfings of several of the chief varieties of Red Crurants and crosses between the species have been made. A number of these seedlings have now been planted in the field and should be large enough for recording during the coming season.

(d.) Statistics.

The most important part of the past year's work has consisted of bringing up to date the records of several of the major field experiments. Owing to the bulk of these records, in several cases, a great deal of simple computation. has been necessary before any analysis of the results could be attempted. It is hoped, however, that the time is not far distant, when the majority of these records will have been summarised into such a form that their examination in detail may be proceeded with.

Assistance has been given to various sections in the planning of new trials. In the laying out of field experiments, an effort has been made to apply a more modern and accurate form of technique than has been used hitherto for horticultural material.

It has been possible to determine how far this technique, which at first sight seemed difficult of execution, has been practicable under field horticultural

conditions, and it may be mentioned here that in every case up to the present it has been found possible to obtain an arrangement of plots which not only is statistically sound, but which is also perfectly practicable in the field.

The first year's results of some of these trials have been examined, and these seem to justify the use of this more accurate technique, at any rate when applied to trials of soft fruits.

Investigations are in progress as to the best method of recording such characters in trees as vigour and fruitfulness.

(e.) Marketing Problems.

Investigations are being continued with regard to the different methods for the marketing of hard and soft fruit with especial regard to the influence of variety, stock, season, etc., and manner of presentation for market.

Six varieties of raspberries of differing characteristics have now been planted up with a view to a comparative marketing trial being carried out.

PUBLICATIONS DURING THE YEAR.

A.9. Annual Report for 1927 (Fifteenth Year) I. General. May, 1928.

A. 10. Annual Report. II. Supplement for 1926-7. October 1928.

Amos, J., Hatton, R. G., Knight, R. C., Massee, A. M. Reversion in Black Currants: Its Cause and Eradication. E.M.R.S. Ann. Report for 1927. May, 1928. I. General, 43-46.

This is a summary of the findings published in earlier papers.

Amos, J., Hatton, R. G. Reversion in Black Currants. Part II. Journal of Pomology and Hort. Science, 1927-8, **6,** 282-295.

SUMMARY.

1. Detailed observations upon a plot of 679 Black Currant bushes which had been lime-sulphur sprayed annually, and had surgical methods applied also, offer no definite evidence of the spread of reversion from bush to bush within the plot during the first four years.

2. A rapid spread of the disease subsequently can be traced to an exceptionally heavy centre of reversion and big bud in close proximity.

3. Under these latter conditions, the single spring lime-sulphur spraying has proved insufficient to stem the tide of such continuous heavy infection.

4. The intensity of the disease and its progress have been very variable from bush to bush. In some cases the apparent development is astonishingly rapid, in others comparatively slow.

5. The frequent replanting of healthy bushes in the place of diseased ones which have been removed does not suggest that infection is carried through the soil.

6. When minor portions of bushes have shown disease, surgical methods have been applied, and though in exceptional instances the removal of reverted portions has resulted in at least a temporary " cure," in the vast majority of cases, the disease has not been materially checked within the individual bush, thereby.

7. On the other hand, the cutting away of diseased parts and the removal of wholly infected bushes are to be urged as sanitary measures.

8. The incidence of reversion in the cutting bed has been studied. The danger of taking cuttings even from apparently healthy portions of diseased bushes is demonstrated. On the other hand, in no instance has a healthy bush resulted from the planting of a reverted cutting.

9. The promising results of applying " roguing " methods (as detailed in Part I. of this paper), to the parent bushes and subsequent cutting beds are set forth after four years' trial.

Chapelow, H. C., Tydeman, H. M. Weather conditions during 1927. E.M.R.S. Ann. Rep. for 1927, May, 1928 (I. General), 85-88. This is a summary.

Grubb; N. H. An analysis of the Effects of Potash Fertilisers on Apple Trees at East Malling, Journal of Pomology and Hort. Science, 1928-9, **7,** 32-59.

SUMMARY.

The application of sulphate of potash to part of the " Pruning Plot " at East Malling has yielded very definite results. In comparison with the untreated trees, with a very few apparent exceptions, those which have received potash have shown :

1. Very much less " leaf scorch."
2. Greatly improved cropping, in both quantity and size of fruit.
3. Greatly increased growth, as indicated, by increase in girth of stem, weight of prunings and number of shoots.

Both 2 and 3 apply to Worcester Pearmain, which is resistant to " leaf scorch," as well as to other varieties.

4. A probable tendency, in certain exceptional cases, towards temporarily reduced cropping as a result of the greater vigour of the tree.
5. A probable tendency in some cases towards a heavier " set " of fruit.
6. No consistent tendency towards more highly coloured fruit. Most of the " leader tipped " trees showed the reverse tendency, probably owing to the shading effect of the denser foliage where potash was applied.
7. An apparent tendency, after the first application of potash, towards earlier maturity of fruit. In most cases this tendency did not persist.
8. Greatly improved financial returns.

Hatton, R. G., Amos, J., Witt, A. W. With Appendix by Hoblyn, T. N. Plum Rootstocks: Their Varieties, Propagation, and Influence upon Cultivated Varieties worked thereon. Journal of Pomology and Hort. Science, 1928-9, **7**, 63.

SUMMARY.

1. The species and varieties of root stocks used for plums are enumerated and discussed.

2. The reasons for using root stocks, and their desirable qualities are suggested.

3. The principal methods of propagation and sources of supply in Europe are described.

4. The behaviour of different root stocks in the nursery is compared, and the phenomenon of "incompatibility" of stock and scion described.

5. The work of previous investigators is summarised.

6. The plan of successional plantings at East Malling is detailed, and the statistical aspect of the records discussed.

7. Figures of the total length of wood growth, girth of stem, height and spread of the branches and total weight of tree, are presented to illustrate the effect of root stock upon the vigour of different varieties.

8. Stock effect on habit of growth is also described.

9. Propensities to a suckering habit are compared and shown to be varietal.

10. The question of firm root-hold is shown to be varietal also.

11. The effect of different root stocks upon:

(*a*) Time of blossoming.

(*b*) Blossom production and nature of spurs, and

(*c*) Actual number of flowers, is illustrated.

12. The relative cropping power of young trees on different root stocks is compared.

13. Some general recommendations are made with regard to the specific uses of individual varieties of root stock.

Tydeman, H. M. The Influence of Rootstocks on the Blossoming of Seedling Apples. A Progress Report. E.M.R.S. Ann. Rep. for 1926 and 1927 (Oct., 1928) (II. Supplement), 51-55.

SUMMARY.

Preliminary trials as to the possible effect of dwarfing and vigorous rootstocks in shortening the "juvenile period" of apple seedlings have been carried out. The data indicate not only the dwarfing effect obtained by the use of certain root-stocks but an undoubted influence of the latter upon blossoming. Thus exactly 50 per cent. of the trees upon dwarfing and precocious rootstocks

blossomed in their sixth year ; of trees comprising the same individual seedlings worked upon vigorous rootstocks less than 9 per cent. blossomed., whilst only one of the parent plants growing upon their own roots has blossomed.

Mackenzie, A. D. The Preservation of Fruit in Natural Colours. The Museums Journal, 1928, **28**, 6-16.

Summary.

Apples, pears, plums, cherries and small fruits, together with their foliage, have been successfully preserved by the use of various modifications of the paraffin, the sulphurous acid, the formalin and the copper sulphate methods.

Owing to the variations of colour and texture, even among individuals of the same variety, the appropriate modifications of the methods have been arrived at by a process of " trial and error."

Specimens thus preserved, when adequately mounted, have so far remained in satisfactory condition, without attention for three years.

Detailed notes of general formulæ of preserving solutions are given, with indication as to necessary modifications.

Rogers, W. S. and *Vyvyan, M. C.* The Root Systems of Some Ten Year Old Apple Trees on Two Different Root Stocks, and Their Relation to Tree Performance. East Malling Research Station Annual Report for 1926-7 (Oct., 1928), II. Supplement, 31-43.

Summary and Conclusions.

(1) Six ten-year old trees of Lane's Prince Albert, of known life history, growing on the Lower Greensand over Kentish Rag, were dug up during the year 1927-8.

(2) The root systems of three of these trees, two on Malling Number I. (vigorous) and one on Malling Number IX. (very dwarfing) were excavated intact, as far as possible. Plans were made of the roots as they were exposed, and photographs afterwards taken of the reconstructed root systems.

(3) Three trees, two on Number IX. and one on Number I, were dug up by the removal of blocks of soil of known size and position. The roots from each block were graded and weighed at once.

(4) None of the trees had a tap root ; the root system of each was composed of a scaffolding of roots running more or less horizontally near the surface of the soil ; from these numerous vertical roots descended at all distances from the trunk, frequently following worms burrows. The depth limit was sent by the rock or the sandy hassock layer just above it ; the roots did not enter this but turned horizontally and formed much fibrous root in the clayey layer just above.

(5) The root system of the Number I. was two to three times as heavy as as that of the Number IX. and spread out farther from the trunk ; it did not descend so deeply but this may have been partly due to the soil happening to be shallower under the Number I. trees than under the Nuber IX. Three-quarters of the Number I. root system and only half that of the Number IX. occurred in the upper 13 inches of soil.

(6) Fibre (roots less than 1 mm. diameter) occurred everywhere, growing in all directions including, vertically upwards ; every root ended in fibre. The proportion of fibre to total root was 14 per cent. in the Number I. and 13.3 in the Number IX.

(7) Only some 10 per cent. of the fibre occurred in the region one yard square at the centre of the tree ; the roots extended considerably farther out than the branches of the trees and some 40 per cent. of the fibre occurred in the outer part of the root system, more than 2½ yards from the trunk. This suggests that it is not a good practice to place manure mainly near the trunk of a tree.

(8) The ratio of stem to root was about the same in both stocks, but that of fruit to root was more than twice as great in Number IX. as in Number I.

The total fresh weight of fruit produced in ten years was in each case greater than the total fresh weight of stem and root.

Hatton, R. G. The Northern Spy Apple as a Rootstock. East Malling Research Station Annual Report for 1926-7 (Oct. 1928) (II. Supplement), 44-50.

SUMMARY.

The growth and early cropping of the variety Grenadier is compared when budded upon Northern Spy and semi-dwarfing, vigorous and very vigorous layered rootstocks.

Under East Malling conditions, Spy would be classed as a semi-dwarfing rootstock, of the Doucin (Malling No. II.) Group, but comparing unfavourably with it in early cropping.

Amos, J. A Progress Report on Winter Pruning Experiments with Pear Trees. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) II. Supplement, 65-71.

SUMMARY.

1. The total length of new annual wood growth is greater in the tipped trees in the first and third season after treatment. In the second season almost identical amounts are made on both unpruned and tipped trees. The amount per shoot has, in the majority of cases, throughout been greater on the latter.

2. The unpruned trees in all cases show a greater girth measurement after the second treatment.

3. Blossom bud formation in early years is reduced by tipping.

4. The leaving of trees unpruned tends to early fruit production.

5. The production of " terminal " and " axillary " blossom buds is shown to be a varietal characteristic.

6. The tipped trees have been less affected by Scab and Canker than the unpruned trees in certain cases.

7. Hard spurring of the laterals, has resulted, in the majority of cases in the production of potential blossom buds.

Witt, A. W. The Vegetative Propagation of Walnuts. East Malling Res. Sta. Ann. Rep for 1926-7 (Oct., 1928) II. Supplement, 60-64.

SUMMARY.

The budding and grafting of Walnuts in the open appears to be frequently a failure as a result of climatic conditions in England.

Successful methods of hard wood grafting in March and of herbaceous grafting in July and August under controlled temperature conditions are detailed.

Attempts to raise rootstocks by soft wood cuttings are described.

Hatton, R. G. The Behaviour of Certain Pears on Various Quince Rootstocks. Journ. of Pomology and Hort. Science, 1928-9, **7**, 216-233.

SUMMARY.

1. Four varieties of Quince used as root stocks commercially and three others of superior vigour were budded with eight Pear varieties.

2. Whilst the percentage of buds which " took " and the nature of the subsequent " maidens " broadly demonstrated a safe and unsafe group of stocks, peculiar varietal preferences were apparent.

3. The subsequent behaviour of the trees demonstrated various manifestations of " incompatibility " on certain rootstocks such as the commercial Type D.

4. Though the normal trees on Quince A, B and C, at present show no significant differences in vigour, those on C have proved outstandingly productive—capacity to make growth and form bloom buds early being united in this variety, which on its own roots is both dwarf and sterile.

5. The vigorous and more free cropping forms of Quince, E. F and G, when used as rootstocks have failed to transmit these characteristics markedly to the scion, even where they have not proved wholly " incompatible."

THE EFFECTS OF VARIOUS FRUIT GROWING PRACTICES ON FRUIT QUALITY AND MARKET VALUE.

By R. G. HATTON.

(Paper prepared for "Growers' Day," Imperial Fruit Show, Manchester, October 25th, 1928.)

One effect of an Exhibition of high-class Commercial Apples such as this, is to arouse many questions in the minds of non-exhibitors.

First and foremost comes the question as to how much fruit, approximating in quality to the exhibits, can and do the competitors produce. That the super-excellence of competitive exhibits is bound to be exceptional, and represents a high watermark rather than an average of attainment, especially where growers are marketing individually, is of course, admitted. Yet previous inspection of the fruit in bulk on the trees has probably convinced many of us that the sources whence the prize winning cases come do in the vast majority of circumstances produce a large percentage of good quality fruit of which the grower can justly be proud.

Two other questions follow in rapid succession. Although it can be done, does it pay to do it, and, if the answer is in the affirmative, where is it that general practice breaks down, and how can it be adjusted to attain its avowed end ?

It is very difficult, coming from an Institution such as I represent to answer the second question in pounds, shillings and pence to the satisfaction of a body of persons whose primary business it is to grow fruit for a livelihood. Although we are each year growing larger quantities of apples commercially, our subsequent handling of them for purposes of recording is, I hope, very exceptional, and I do not propose in the short time available to quote what may be misleading figures to answer my own question as I believe it can be answered.

Rather, our contribution from East Malling should be to shed some light upon the effects of general practice upon the growing of good quality fruit.

It has been a large part of our work to apply many varying treatments to the fruitgrower's material, on a fairly comprehensive scale in the field, and to record closely the results. Various methods of winter pruning, of scab and insect pest control, and more recently, the effects of feeding and starvation, and of fruit thinning, have been explored. In the early life of our plantations the main effects which could be chronicled were those upon the growth and vigour of the trees, but now that much of our material is from ten to fourteen years old it is possible to review the effect of our treatments upon the fruit crops and to see

not only how far these total crops have been affected, but how far the size, freedom from blemish, colour and quality of the produce, has been altered. From this point of view our crop records have been carefully examined during the last few years, and I would like to quote some typical cases under each of my four headings.

1. Winter Pruning.

Mr. Grubb's Pruning Plot is now so well known to the majority of commercial growers that there is no need to enter into details of its lay-out here. Nor do I want to forestall the complete analysis of his results to date which he promises to let us have shortly, but he summarises the effects of his pruning on fruit quality, as follows :—

(*a*) Pruning has undoubtedly increased fruit *size*. Whilst his "regulated" series—i.e., those that have been more lightly thinned—have usually borne larger fruit than the unpruned trees, the trees which have been leader tipped and spur-pruned annually have nearly always borne larger fruits than either. It is interesting to note that as far back as 1921, when the trees were still quite young, this was emphasised, though in these years "in most cases the greater value of the larger fruit is not yet enough to compensate for the loss of crop due to tipping, but this may be reversed with all but a few varieties in the next year or two." Mr. Grubb can now fully confirm his own prediction. He has supplied the crop figures for three very different varieties, Lord Derby, Lane's Prince Albert, and Rival, for the years 1925, 1926, and 1927.

In the case of Lord Derby, the average return (after deduction of carriage and commission) per acre, was :—

For the Unpruned Trees.	£32 13s., and average net price per bushel, 2s. 10d.
For the Tipped Trees.	£40 13s., and average net price per bushel, 3s. 5¾d.

In the case of Lane's Prince Albert, the figures were :—

For the Unpruned Trees.	£44 13s., and average net price per bushel, 3s. 1d.
For the Tipped Trees.	£56 2s., and average net price per bushel, 3s. 8d.

In the case of Rival, the figures were still more striking :—

For the Unpruned Trees.	£55 19s., and average net price per bushel, 7s.
For the Tipped Trees.	£78 15s., and average net price per bushel, 9s. 2d.

The prices for the fruit from the " regulated " trees in every comparison but one occupied an intermediate position.

Thus, as Mr. Grubb has foreshadowed in each succeeding report, increased severity of pruning would become more and more justified with the increasing maturity of the trees. At least from ten years old and onward this pruning has had a marked effect on the size of the fruit.

(*b*) *Pruning helps the Control of Scab.* Apart from the easier—and hence more effective—spraying, made possible in trees with well spaced branches etc., the Tipped and Spurred Trees have almost invariably produced cleaner fruit.

In 1921, Mr. Grubb instanced the case of Worcester Pearmain " where the unpruned and open centre trees average 40 per cent. of their fruit more or less scabbed, the scabbed fruit on the tipped trees is usually 5 per cent. or less." He has handed me sufficiently confirmatory figures for unsprayed trees, James Grieve, in the present (1928) season, when 60 per cent. of the fruit was clean on the tipped and spurred trees, and only 38 per cent. on the unpruned and regulated. Whilst it is partly a question of the removal of sources of infection, this is not the whole story.

(*c*) *Pruning reduces blemishes caused by wind injury*, and generally facilitates such operations as fruit thinning.

(*d*) Pruning affects *colour*.

In the case of varieties where colour is one of the assets for market value, the fact that tipped and spurred trees nearly always have the poorest coloured fruit must be borne in mind. It is probably at least in part a question of the shading by lateral growths of the fruit borne in the centres of these trees as compared with the fruit on unpruned trees which is largely on the outside of the tree. This can doubtless be partly corrected by the removal in summer of offending shoots and leaves.

In 1925 Mr. Grubb stated that " entirely unpruned trees produce poorer coloured fruit than trees thinned out, even with no tipping. The latter in fact produce the best-coloured fruit of all."

2. Spraying.

So far as the Fruit Quality is concerned, the English grower has generally only one serious fungus disease to fear—Scab—and that is ever present with him. For this reason, as far back as 1919 Tests of Fungicides on Apple Trees were initiated at East Malling. It was realised that the issues were not simple, and that a wide field of varietal susceptibilities, chemical combinations and meteorological reactions would have to be explored. The work is still far from complete, but the data already collected are sufficient to show that judicious

spraying against scab is an essential routine in the production of high class apples.

If the evidence published by Mr. Grubb between the years 1921 and 1924 needs any reinforcing on older trees, the figures are still forthcoming. To instance the variety James Grieve, and the tipped trees. In 1919 the percentage of clean fruit on the sprayed trees was 77, on the unsprayed 40; in 1920 the figures were 77 and 19 respectively, in the present season (nine years later), the sprayed trees gave 91 per cent. fruits unblemished, by scab, and the unsprayed only 38 per cent. entirely free. The tipped trees tell a similar if slightly less startling story. Time and space will not allow here of a digression upon the merits and demerits of various fungicides upon different varieties under different sets of circumstances, though it must be emphasized that considerations such as these are essential to spraying which will produce good quality fruit.

Almost certainly many a crop full of promise is ruined by injudicious spraying and in addition thousands of pounds wasted. That is why the cry is so often heard that the results of spraying are not commensurate with the costs.

As the figures already quoted from our unsprayed trees have shown, the present season at East Malling was a comparatively favourable one for the development of scab, yet we have never grown a cleaner crop of fruit (with over 90 per cent. control on the average), where it was possible to carry through our routine spraying at the proper season.

Our general spraying programme, of which I propose to give a description and detail the cost, took into account the chief insect pests which are a menace to fruit quality, aphis, sawfly and capsid.

Fortunately, the apple capsid (*Plesiocoris rugicolis*) has not as yet been found on the Research Station, so that only the two former had to be considered. The precautions taken proved more than adequate, but I propose to leave Mr. Massee to tell his own story of Sawfly Control in due course.

Our typical spray schedule for the plantations from ten to fourteen years old was as follows :—

January 19th—25th. 10 per cent. Tar Distillate Wash. The average cost of the application on 14 year old trees was slightly under 8d. per tree or £7 6s. per acre (trees at 14 feet).

April 23rd. "Pink Spray." Lime Sulphur (1 in 30) + Arsenate of Lead (4 lbs. to 100 galls.) + 1 lb. Gelatine per 100 galls. The average cost of the application was about 4½d. per tree (14 year olds) or £4 3s. per acre.

May 23rd. "Post Blossom." Lime Sulphur (1 in 100) + Arsenate of Lead and Gelatine as before. Nicotine 5 ozs. per 100 galls. was also included. The average cost of the application was approximately 5½d. per tree, or £5 per acre.

June 18th. " 2nd Post Blossom." Colloidal Sulphur (5 lbs. to 100 galls.), Soft Soap (5 lbs. per 100 galls), Nicotine (6 ozs. per 100 galls.). The average cost of the application was approximately $2\frac{3}{4}$d. per tree, or £2 11s. per acre.

The detailed costs of these sprays will be found in the appendix.

Thus the total cost of one year's spraying on scab susceptible varieties, was about £20 per acre. Whilst on the one hand, undoubtedly experimental exigencies such as the inclusion of entirely unpruned trees would enhance these costs, probably our specialist knowledge effectively counterbalanced this, and we suggest that on scab susceptible varieties a cost approaching this figure must be faced by the commercial grower aiming at first quality fruit. The cost should be considerably less on varieties resistant to scab, and the cumulative effect of spraying clearly demonstrated in our early experiments leads one to hope that from time to time figures may be reduced. On the other hand, the random omission of any item in such a logical schedule may have very serious consequences. We have evidence to show that in the case of Worcester Pearmain and James Grieve, the omission of the 1st Post Blossom Spray this year, reduced the crop by as much as one quarter to a half quite apart from the less effective control of scab.

The figure suggested by Mr. J. Turnbull, in " Modern Fruit Tree Spraying and what it costs," " to deal effectively with the general run of pests in a fully grown apple plantation " is approximately half, but our schedule is a rather more comprehensive one especially designed for scab susceptible varieties.

The varieties subjected to the full schedule were :—Allington Pippin, Bismarck, Cox's Orange Pippin, James Grieve, Newton Wonder and Worcester Pearmain, and if the crop of all varieties be pooled, it averaged 380 bushels per acre. At the ridiculously low average figure for high quality fruit of 4s. per bushel, the gross return would be £76 per acre. A deduction from this of £20 per acre for spraying alone would appear a very serious item, but with such good quality fruit it has actually been much more than balanced by improved possibilities of marketing. Further, crops can be increased, in both bulk and quality, by the application of a more consistent and carefully thought out policy in other operations.

3. Feeding.

In view of the fact that Mr. T. Wallace is contributing a paper on " Manuring in relation to fruit quality," I do not intend to elaborate this point in detail. As far back as 1919 we laid down our first field trials designed to call in question the traditional manuring of the average good grower—a practice which was costing us in the neighbourhood of £10 per acre per annum. There

will be an interesting story to tell of these plots one day, but at the moment I merely want to give a concrete example of where the putting into practice of Mr. Wallace's principle of a judicious balance has brought a most handsome return at a greatly reduced cost, by its effect on the bulk, size and quality of the resulting crops.

The full detail is given by Mr. Grubb in his recently published "Analysis of the Effects of Potash Fertilisers on Apple Trees at East Malling," but I would just like to compare the difference in the value of the crops off the traditionally manured plots with that of the high quality fruit off those manured on scientific principles. The three very different varieties already instanced in the case of pruning will serve.

The average value per acre for the three years 1925-27 :—

In the case of Lord Derby on the "Potash" plots was £50 19s. per acre, and the net price per bushel 3s. 6d. as compared with £27 9s., and 2s. 10d. on the "No Potash" plots.

In the case of Lane's Prince Albert, the "Potash" plots yielded £57 3s. at an average net price per bushel of 3s. 6d. as against £41 13s., and 3s. 2d. from the "No Potash" plots.

The figures for Rival were £93 10s., and 8s. 6d. from the "Potash" plots, and £47 16s. and 7s. 10d. from the "No Potash" ones.

These prices are worked out from the prices actually received for the fruit as marketed in the various size grades taken in proportion to the actual quantity of each grade from the various plots.

This improvement has been brought about as a result of four annual dressings of sulphate of potash (4 cwt. per acre) costing approximately £2 9s. per acre per annum. The expensive, bulky, almost purely nitrogenous dressings have been greatly modified, and the complete manurial bill is reduced to less than half.

Details of the cost of traditional manuring and of potash are given in the Appendix.

That manuring is affecting both colour and maturity of fruit seems certain though an interpretation of the reactions of trees in the field to certain dressings in particular seasons involves the consideration of so many factors that no hasty conclusions can be drawn from these experiments. In the present season (1928) the improvement in the colour of the non-shaded fruit of certain varieties, such as Newton Wonder, Allington Pippin and Cox's Orange Pippin was very obvious to the eye when the fruits were still on the trees.

4. Fruit Thinning.

Although some of our most progressive growers in this country have practised the thinning of their fruit for some years past, the adoption of this

practice appears largely to have been based upon common sense reasoning and observation backed by some experimental data from America. That the results of thinning appear to be as effective in producing uniform high grade fruits in this country as in America is generally admitted by those who visit plantations so treated. From the grower's point of view the irresistible question " Does it pay ? " is bound to occur ; from the investigator's, the fear immediately arises that there is likely to grow up a tradition of thinning rather than an adaptable practice based upon an intimate knowledge of the processes involved. Both these points of view demand some exact experimentation for English climatic conditions and with English varieties. Unfortunately trees of known history and of a sufficiently mature age have not been available in any number at the Research Station until the present season, though preliminary trials were started a year previously.

The only previous data to which it was possible to refer was that collected in 1926 by Mr. W. S. Rogers, of East Malling, upon a small experiment initiated by Mr. E. F. Guthrie, of Paddock Wood, in which control (unthinned) trees had been left for comparison. The full details have already been published in the " Fruit Grower "—and they show that on a comparison of two thinned and two unthinned eighteen to twenty year old trees of two varieties, both bearing heavy crops and selected as being reasonably comparable " the effect of thinning the fruits . . . was most marked and beneficial." Not only were " the number and percentages of apples in the larger sizes very much larger on the thinned trees than on the unthinned " but " the increase in weight of saleable fruit was about 90 lbs. per tree," though in total weight and count the unthinned trees headed the list owing to the large number of unsaleable " scrumps." Finally the effect on improvement in colour was most encouraging. The data so far collected at East Malling upon ten and nine year old trees—presumably in the main only just reaching maturity—whilst they bear out the fact that under most conditions fruit thinning is bound to increase the size of the remaining fruit, emphasizes the suggestion put forward by Mr. Rogers that other factors would have to be taken into account.

For instance, the fact that the trees on the early maturing Jaune de Metz Rootstock (Malling No. IX.) at present show a response to thinning far more definite than for the same varieties on any other rootstocks, is suggestive of the age factor. Again there are indications that thinning will have to be adapted not only to variety but to the method in which the tree has been shaped and pruned. Finally there is a preliminary warning that at any rate in young trees there may be a point of severity beyond which profits are actually reduced. The figures furnished the writer by Mr. A. C. Painter from ten-year-old Lane's Prince Albert trees in full crop—half of which were lightly thinned and half left unthinned—show an increased net return on the former of £26 an acre. This

leaves a handsome margin of profit after deducting the cost of thinning operations which amounted to £3 5s. per acre (4d. per tree).

A judiciously planned scheme of thinning will, I believe, become part of the normal routine of every well managed commercial orchard aiming at producing first quality fruit for a livelihood, but like all the other operations already detailed it must be based on intelligent observance which adapts its practice readily according to circumstance.

Influence of Rootstocks.

Finally I cannot omit to put in a word upon my own special subject as being appropriate. Many growers are saying, whether rightly or wrongly I don't propose to express an opinion, that high quality fruit can only be grown to the best advantage for a comparatively short period during the tree's early maturity, and that in order to maintain this high standard successional plantings must be planned for. If growers are convinced of this the more precise knowledge now available with regard to rootstock effect and suitability can ensure the satisfactory attainment of their aim. For not only can they choose material with different periods of maturity, but they can definitely pick and choose material on which they can confidently expect the highest quality fruit. Each successive fruiting season strengthens our early findings that size, colour and quality of fruit are affected by rootstocks, and, in the present season, trees on the Doucin Amélioré (No. V.) have uniformly given one more proof of the undesirability of this widely spread and misnamed rootstock in the outstandingly poor quality fruit produced. Though the trees were by no means cropping excessively in comparison with their neighbours, the fruit in size, colour and freedom from blemish was most inferior. On the other hand the pre-eminent quality of dessert apples borne upon the trees on Jaune de Metz (No. IX.) lead one to dream that one day there may be growers bold enough to try out at least on a small scale, the proved practice of the apple growers of the Rhineland in successional plantings entirely upon that stock, where suitable conditions prevail.

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APPENDIX.

DETAILS OF SPRAYING COSTS AT EAST MALLING.

A. PLOTS 3 and 4. 640 fourteen to fifteen-year-old bush apples at 14 feet square.

I. TAR DISTILLATE. 10 per cent.

	£	s.	d.
Spray.			
10 gallons Wash @ 2s. 6d.	1	5	0
90 gallons Water			3
	1	5	3
1,450 gallons Spray used	18	6	2
Labour.			
6 men, 12 hours @ 8¾d.	2	12	6
Petrol.			
2 gallons @ 1s. 2d.		2	4
	£21	1	0

Quantity of Wash per tree	2.27 gallons.
Total cost per acre (222 Trees) ..	£7 6 0
Cost per tree	7.89 pence.

II. Pre Blossom. Lime Sulphur 1 : 30.

Spray.	£ s. d.
3⅓ gallons Wash @ 1s. 5d.	4 9
96⅔ gallons Water	3
4 lbs. Arsenate Paste @ 1s.	4 0
1 lb. Gelatine @ 1s. 4d.	1 4
	10 4
1,700 gallons Spray used	8 15 8
Labour.	
6 men, 14 hours @ 8¾d.	3 1 3
Petrol.	
2 gallons @ 1s. 2d.	2 4
	£11 19 3

*Quantity of Wash per tree	2.66 gallons.
Total Cost per acre (222 trees) ..	£4 2 9
Cost per tree	4.48 pence.

III. Post Blossom. Lime Sulphur 1 : 100.

Spray.	£ s. d.
1 gallon Lime Sulphur @ 1s. 5d. ..	1 5
4 lbs. Arsenate Paste @ 1s.	4 0
†5 ozs. Nicotine @ 12s. 6d.	4 0
1 lb. Gelatine @ 1s. 4d.	1 4
Water	3
	11 0
1,950 gallons Spray used	10 14 6
Labour.	
6 men, 16⅔ hours @ 8¾d.	3 12 11
Petrol.	
2½ gallons @ 1s. 2d.	2 11
	£14 10 4

* It should be noted that the pre-blossom sprays were applied in somewhat excessive quantity to both sets of trees to obtain some control over Red Spider which was prevalent.

† Nicotine was included in the post-blossom sprays owing to the presence of rosy apple aphis.

*Quantity of wash per tree	3.0 gallons.
Total cost per acre (222 trees) ..	£5 0 7
Cost per tree	5.44 pence.

In the case of varieties for which Lime Sulphur is omitted the figures are :—

Total Cost per acre (222 trees)	£4 10 7
Cost per tree	4.9 pence.

IV. Second Post Blossom. Colloidal Sulphur 5 : 100.

	£ s. d.
Spray.	
5 lbs. Colloidal Sulphur @ 1s. 3½d. ..	6 5
5 lbs. Soft Soap	1 10
†6 ozs. Nicotine	4 9
Water	3
	13 3
700 gallons Spray used	4 12 9
Labour.	
5 men, 14 hours @ 8¾d.	2 11 8
Petrol.	
2 gallons @ 1s. 2d.	2 4
	£7 6 9
Quantity of Wash per tree	1.1 gallons.
Total cost per acre (222 trees) ..	£2 10 10
Cost per tree	2.75 pence.

B. Plots 12, 13, 14. 750 ten-year-old trees at 15 feet square. Worcesters and Bramleys.

I. Tar Distillate. 10 per cent.

	£ s. d.
Spray.	
10 gallons Tar Distillate @ 2s. 6d. ..	1 5 0
Water	3
	1 5 3

* See footnote, page 56.

† See footnote, page 56.

	£	s.	d.
1,250 gallons Spray used	15	15	7
Labour.			
6 men, 10 hours @ 8¾d.	2	3	9
Petrol.			
2 gallons @ 1s. 2d.		2	4
	£18	1	8

Quantity of Wash per tree	1.66 gallons.
Total cost per acre (193 trees)	£4 13 3
Cost per tree	5.79 pence.

II. Pre Blossom. Lime Sulphur 1 : 30.

Spray.	£	s.	d.
3⅓ gallons Lime Sulphur @ 1s. 5d. ..		4	9
4 lbs. Arsenate of Lead @ 1s.		4	0
1 lb. Gelatine @ 1s. 4d.		1	4
Water			3
		10	4
1,550 gallons Spray used	8	0	2
Labour.			
6 men, 8⅓ hours @ 8¾d.	1	16	5
Petrol.			
2 gallons @ 1s. 2d.		2	4
	£9	18	11

*Quantity of Wash per tree	2.06 gallons.
Total cost per acre (193 trees)	£2 11 1
Cost per tree	3.18 pence.

* See footnote, page 56.

III. Post Blossom. Lime Sulphur 1 : 100.

Spray.	£	s.	d.
1 gallon Lime Sulphur @ 1s. 5d. ..		1	5
4 lbs. Arsenate of Lead @ 1s.		4	0
1 lb. Gelatine @ 1s. 4d.		1	4
†5 ozs. Nicotine @ 12s. 6d. lb.		4	0
Water			3
		11	0
2,100 gallons Wash used	11	11	0
Labour.			
6 men, 10 hours @ 8¾d.	2	3	9
Petrol.			
2 gallons @ 1s. 2d.		2	4
	£13	17	1

*Quantity of wash per tree	2.8 gallons.
Total cost per acre (193 trees)	£3 12 0
Cost per tree	4.48 pence.

IV. Second Post Blossom. Colloidal Sulphur 5 : 100.

Spray.	£	s.	d.
5 lbs. Colloidal Sulphur @ 1s. 3½d. ..		6	5
5 lbs. Soft Soap @ 4½d.		1	10
†6 ozs. Nicotine		4	9
Water			3
		13	3
750 gallons Spray used	4	19	5
Labour.			
6 men, 13 hours @ 8¾d.	2	16	10
Petrol.			
2 gallons @ 1s. 2d.		2	4
	£7	18	7

Quantity of Wash per tree	1.0 gallons.
Total cost per acre (193 trees)	£2 0 10
Cost per tree	2.54 pence.

* See footnote, page 56. † See footnote, 56.

Details of Apple Manuring Costs over a Period of Years at East Malling,

allowing a comparison of the traditional earlier applications and the later potash.

A. Plots 3 and 4. Fourteen to fifteen-year-old trees at 14 feet square.

		£	s.	d.
1922.	15 tons London Dung	11	5	0
1923.	30 cwts. Shoddy	5	5	0
	2½ cwts. Potash	1	7	6
		6	12	6
1924.	12 cwts. Meat and Bone	5	2	0
	Peruvian Guano	3	0	0
		8	2	0
1925.	4 cwts. Potash	2	4	0
	17 Tons Dung	12	15	0
		14	19	0
1926.	4 cwts. Potash	2	4	0
	12 cwts. Meat and Bone	5	2	0
		7	6	0
1927.	As in 1926	7	6	0
1928.	4 cwts. Sulphate of Potash	2	4	0

B. Plots 12 and 13. Ten-year-old trees at 15 feet square.

1925.	30 cwts. Shoddy	5	5	0
	6 cwts. Rape Dust	2	11	0
	4 cwts. Muriate of Potash	1	16	0
		9	12	0

		£	s.	d.
1926.	12 tons Dung	9	0	0
	6 cwts. Meat and Bone	2	11	0
		11	11	0
1927.	3 cwts. Sulphate of Potash	1	11	0
	10 cwts. Meat and Bone	3	8	0
		4	19	0
1928.	2 cwts. Sulphate of Potash	1	2	0
	6 cwts. Meat and Bone	2	11	0
		3	13	0

APPLE PRUNING.

SUMMARY OF DEDUCTIONS FROM EXPERIMENTS AT EAST MALLING.

(*Revised January*, 1929).

By N. H. GRUBB.

The last of three popular leaflets describing the results of winter pruning experiments with apple trees, published in October, 1925, is now out of print. Since requests for advice on pruning are still very frequently received, it seems advisable to re-issue this last summary, revised in certain respects where later developments suggest a slight modification of the emphasis and with a few additional notes.

A. Objects and Methods of Pruning.

The branch pruning of fruit trees is done with one or more of these objects in view :

1. *To shape the tree*, particularly in its early years, by providing enough, and not too many, branches :
   - (*a*) Suitably spaced,
   - (*b*) Stout enough to hold up a heavy crop of fruit.
   - (*c*) Well furnished with fruit spurs.

This enables the tree to make the most efficient use of the space it occupies ; it also facilitates such operations as spraying, cultivation, picking the fruit, etc.

2. *To control the production of fruit buds and blossoms*, in
   - (*a*) Number.
   - (*b*) Position.
   - (*c*) Quality.

Since the unpruned tree, in its early years produces more blossoms than a tree pruned by whatever method (except root-pruning), we do not " prune for fruit bud formation." But we often prune to secure the formation of fruit buds where we want them, instead of where they would be formed naturally. It is often advisable, also, to prune in order to reduce the number of fruit buds.

3. *To maintain vigour*, either
   - (*a*) To secure a tree of the required size (usually by delayed cropping), or
   - (*b*) To aid in " setting " enough blossom to produce a good crop, or
   - (*c*) To contribute to the general health and efficiency of the tree.
4. *To improve the quality of the fruit* particularly its size, colour, etc.

5. *To help in controlling diseases and pests.*

(*a*) By making efficient spraying easier.

(*b*) By cutting out actual infections.

(*c*) Probably also by a reaction of the pruning on the health of the tree, making it more resistant to certain diseases.

6. *To check,* and possibly help to control, "*biennial bearing.*"

7. *To prevent the tree from occupying more than its allotted space.*

8. *To help in renovating old and neglected orchards.* Here pruning is nearly always the first treatment needed.

Three distinct operations may be recognised in the pruning of apple trees.

1. "*Leader tipping,*" the shortening of the "leader," or shoot that extends the branch (or forms a new one). This operation is required mainly for shaping the tree, maintaining vigour, and furnishing the branches with spurs.

In later years a similar, but more severe, operation is sometimes required, called variously "jointing back," "heading back," or "dehorning," according to severity. This is practised with mature trees, either to reduce their height, or to restore their vigour. The branches are cut back into wood sometimes as much as ten years old, preferably just above a side branch.

2. "*Thinning,*" either by

(*a*) Cutting clean out strong lateral and unneeded growths which crowd the tree, or

(*b*) Shortening the weaker crowding growths (to fruit buds where available).

3. "*Spurring,*" or "Spur pruning," a two or three year operation. The weaker lateral shoots are shortened to from three to five (or even more) strong buds; fresh growths resulting from this cut are again shortened until a definite blossom bud is formed; the spur is then cut back to this blossom bud.

B. Pruning Required at Different Stages of Growth.

As far as pruning is concerned, the life of the tree may be divided into three periods.

1. *The young tree.*

In the first period, up to four or five years (or in some cases even eight or ten years), the object is to shape the tree, and procure a sturdy framework with enough branches properly spaced. It is generally necessary to shorten or "tip" the leaders severely at first, and less severely later, removing perhaps two-thirds or three-quarters of their length at first, and from one-half down to one-quarter or less as the tree takes on the required shape. Little "spurring" is done in this period.

2. *The adolescent tree.*

In the second period the object is to bring the tree into cropping, more or less quickly according to the particular needs and purposes of the grower. The treatment is governed by the fact that, while long continued leader tipping gives a more satisfactory mature tree, it almost always causes a delay in cropping; for early cropping, leader tipping must be quickly reduced in severity.

3. *The mature tree.*

The third period covers the rest of the tree's life. The treatment consists largely in thinning out the head of the tree, with, where necessary, a moderate or severe leader tipping or occasional "dehorning."

C. Pruning must be Adapted to Root Stock and Soil.

The delay in cropping due to leader tipping is much more serious amongst trees on vigorous root stocks than amongst those on dwarfing stocks. Young trees on very dwarfing stocks will fruit even when severely tipped, whilst tipping of the same severity might delay the cropping of trees on very vigorous stocks almost indefinitely.

Similarly young trees growing in soil which normally produces dwarf growth can safely be tipped more severely than trees, even on the same root stocks, in soil where growth is more vigorous. In most cases one has to judge the degree of tipping needed by the vigour of the trees; and it is usually advisable, though it may be a "counsel of perfection," to vary the tipping according to the needs of each individual tree.

D. Pruning Permanent and "Filler" Trees.

"Filler" trees are intended to crop quickly, and produce a good return before the permanent trees need all the space. Leader tipping almost always delays cropping; it can easily be overdone with "fillers."

Note our results:

Total crop in bushels per acre up to ninth year.

	Leader tipped.	Not tipped.
Early Victoria	173	522
Grenadier	70	209
Lane's Prince Albert ..	82	242

In each case the untipped trees bore about three times as much fruit as the tipped up to the ninth year—a serious matter where early returns are imperative. "Filler" trees, being short lived, need not have as stout a framework or as good a shape as permanent trees—two of the chief reasons for the severe tipping of young trees.

It is not suggested that leader tipping of " filler " trees should be entirely abandoned ; only that it should be less severe than that of permanent trees of the same or other varieties.

E. Effects of Over and Under Pruning.

Although it is important not to delay the cropping of " filler " trees unduly, there is another side to the picture. Quality of fruit counts also. Certain varieties, if left several years without leader tipping (particularly if they are on certain dwarfing stocks) are apt to produce large quantities of very small fruit. Of these the worst are Allington and Cox's Orange ; but nearly all varieties show the same tendency, several to an extent that markedly affects the value of the crop. It is not yet known how far this tendency can be overcome by thinning the fruit ; but this operation seems to be less effective with young than with fully mature trees.

On the other hand, too severe and long continued tipping before the trees come fully into cropping often produces very crowded wood growth, particularly with Allington.

In such cases correct pruning involves very light tipping during the second (adolescent) period, or sometimes none at all, until the trees bear well, and then more severe tipping to maintain size of fruit.

Size of fruit counts also in the case of " fillers." Entirely unpruned trees produce smaller fruit (and usually less highly coloured in the case of coloured varieties) than trees thinned out even with no leader tipping. " Thinning out " pays, even where tipping is inadvisable.

F. Maintaining Vigour.

The fact that untipped trees (particularly of Allington and Cox's Orange) bear much very small fruit is connected with the weakness and unhealthy condition of the trees. In the early years the untipped trees in our trial cropped well, and their fruit was large enough to satisfy market requirements, whilst the tipped trees were producing little fruit. Later on, although the tipped trees frequently produced even heavier crops than the untipped trees, their fruit was nevertheless larger than that of the untipped trees. Nothing but the vigour and relative freedom from disease of the tipped trees will account for this fact.

Many old and neglected orchards and plantations are in the condition of our untipped trees (or worse). In such cases a fairly severe pruning, often with a moderate " heading back " or " dehorning " of the branches, greatly increases the size of the fruit, and frequently also the quantity.

G. Pruning Helps in Controlling Diseases and Pests.

The tipped trees in our trial have been (and still continue) notably freer than the untipped trees from scab (black spot), mildew, ordinary apple canker and blossom wilt canker. This is no doubt largely due to the removal by pruning of sources of infection. It pays to cut away as much diseased wood as possible at the winter pruning.

But pruning also makes the tree easier to spray, by keeping the head more open and accessible. This helps in the control of insect pests as well as diseases.

It seems fairly certain also that the tipped trees are definitely more resistant to certain diseases, particularly scab and canker.

It is not suggested that pruning by itself will control these diseases, except perhaps in a year when the attack is very slight ; but it is an important aid to their control.

H. Pruning Must be Adapted to the Variety.

Varieties differ very much in their habit of growth and cropping. A method or degree of pruning which gives excellent results with one variety may be quite unsuitable for another, even under similar conditions.

The most important differences arise in the second (adolescent) period of the tree's life (see above). The losses resulting from unintelligent " rule of thumb " pruning, in which all varieties are treated alike, are very much less in the first period (except for the necessity of treating " filler " trees differently from permanent trees), and in the third (mature) period, than in the stage when it is desired to bring the tree into cropping.

The best known example of a peculiar habit of bearing is probably the " tip bearing " habit of such varieties as Worcester Pearmain. This variety, in its adolescent period, produces almost all its fruit buds on the tips of shoots from, say, six to eighteen inches long. If these are all cut away or shortened there may be a quite unnecessary delay in cropping.

Newton Wonder, on the other hand, whilst it also produces large numbers of " tip " fruit buds, in our conditions also produces many fruit buds on natural spurs (unless the tree is over pruned). Consequently cutting away the tip fruit buds from Newton Wonder has not in our trial delayed cropping in the same way as it has with Worcester Pearmain.

Note these figures :

Average number and weight of fruits per tree.

Eighth year.

	Tipped.	Not Tipped.
Newton Wonder ..	56 fruits. 16 lbs.	42 fruits. 9 lbs. 12 ozs.
Worcester Pearmain ..	32 fruits. 7 lbs.	214 fruits. 31 lbs.

Numerous other examples might be given, as for instance the contrast between Lord Derby (spur bearing) and Bismarck (tip and "axillary" bearing).

Growers would be well advised to look out for this tip bearing habit, and allow for it in pruning wherever it is pronounced enough to affect early cropping. The varieties in which it is most likely to be seen are :

Bramley's Seedling.
Bismarck.
Gladstone.
Worcester Pearmain.

Grenadier has a similar habit when very young, but usually begins to produce spur fruit buds earlier than those named. In conditions different from ours, also, Newton Wonder would often have to be included.

The following varieties may usually be relied on to produce natural spurs freely, unless too severely tipped :

Allington.
Cox's Orange.
Early Victoria.
James Grieve.
Lane's Prince Albert.
Lord Derby,

and to a less extent, Rival.

Habit of growth must also be allowed for in pruning. Where it is proposed to continue tipping for several years, in order to make the branches stout, it is best to tip upright growing varieties to an outward pointing bud, and spreading varieties to an upward one. In some cases, where tipping is light, it is better to tip even upright varieties to an upward or inward bud, to counteract the spreading effect of heavy cropping.

The most upright varieties in our trial are :

Annie Elizabeth.
Lord Derby.
Worcester Pearmain.

The branches of Lord Derby, however, are very slender, and much apt to be pulled down by cropping unless tipping is fairly severe and long continued.

Distinctly spreading varieties are :

Allington.
Beauty of Bath.
Bramley's Seedling.
Gladstone.
Lane's Prince Albert.
Norfolk Beauty.

Bismarck and Cox's Orange soon become spreading if left with little or no tipping when young. Newton Wonder is somewhat upright when young, but

usually becomes spreading owing to the growth of more or less horizontal branches, even before it begins to crop freely.

Certain varieties are apt to make long bare branches with few spurs, unless the leaders of the young tree are tipped. In our trial the worst has been Bismarck, followed by Newton Wonder, Worcester Pearmain, and Annie Elizabeth. Our variety collection, in which one or more trees of each variety are tipped and others untipped, suggests that there may be varieties which furnish their branches better *without* tipping. It is probable, however, that such varieties are rare.

Six varieties in our pruning trial have furnished their branches well, even when untipped—Allington, Early Victoria, Grenadier, Lane's Prince Albert, Lord Derby, and Norfolk Beauty.

J. Length of "Spurring."

Although in our experiment two lengths of "spurring" are under trial—"spurring" to one good bud and to three good buds—the result is in nearly all cases so markedly in favour of the longer cut, that we now make the recommendation noted above, "the weaker laterals are shortened to from three to five (or even more) good buds." It may be laid down as a general rule that the younger the tree, or the stronger the lateral to be spurred, the longer should be the portion left. It is not usually found worth while to do any "spurring" at all on very young trees, or to "spur" very vigorous laterals even on mature trees. Nevertheless, "spurring" in general is much more successful with mature or maturing trees than with young or adolescent trees. A "three bud" cut on a mature tree may produce a fruit-bud in one year, where it would take two years with a young tree, even, if the cut were to five buds.

With certain varieties, notably Cox's Orange, "spurring" to one good bud leads to the death of many of the "spurs" so cut. Even where such "spurs" always survive, there has been no indication in our trial that any of our fifteen varieties will ever produce a fruit bud more quickly when cut to one bud than to three buds. All the indications are in the opposite direction.

K. Biennial Bearing.

Early observations suggested that our untipped trees were developing the biennial habit to a greater extreme than the tipped trees. This has been in large measure maintained; but we now know, as the result of another trial, that when the biennial habit is already strongly developed, it will at least require very drastic pruning to correct it. It still seems probable, however, that if young trees are watched closely and always pruned more severely in the winter when fruit buds are numerous, there will at least be some delay in the development of the

biennial habit. It will be necessary, of course, to distinguish in pruning between trees in their " on " year and trees in their " off " year ; it seldom happens that all trees of any one variety crop in the same year.

In order to control the biennial habit when it is already strongly developed, we shall probably have to practise thinning either the dormant fruit buds or the blossoms before they are " set."

THE EFFECTS OF POTASH FERTILISERS ON APPLE TREES.

By N. H. GRUBB.

A REPORT on this subject which appeared in *The Journal of Pomology and Horticultural Science* (Vol. VII., Nos. 1 and 2, July, 1928), has brought many enquiries from fruit growers and much interesting correspondence. As a result it seems well to re-emphasise certain points which in the report were only implicit, or to which only passing reference was made, and to add some advice which may be of value to growers.

It must be stated as strongly as possible, firstly, that such benefits from potash manuring as we are able to show are likely to occur with apple trees *only where leaf scorch is more or less in evidence* (and perhaps not even there, if the cause of the leaf scorch is water-logged soil). Readers of *The Journal of Pomology* who have closely followed Wallace's reports on the Pot Culture work at Long Ashton will probably be familiar enough with this fact; it is also implied repeatedly in our report, by the constant references to leaf scorch. But it has been overlooked by a number of our correspondents who have read the report, and must therefore be stated in so many words.

Growers should realise that where trees grow vigorously without any sign of leaf scorch, heavy dressings of potash are likely to be largely wasted.

There is as yet very little evidence to show whether, or to what extent, potash manures are a remedy for leaf scorch caused by water-logged soil. In any case, it is plain that the radical cure for leaf scorch in such conditions is better drainage, whether obtained by tile draining, by cultivating up and down the slope, or in some other way. It is not likely, in any case, that potash could have its full effect until the drainage is improved; and once that is attended to, potash will often be unnecessary.

The question has frequently arisen as to the quantity and frequency of potash dressings required for the cure or prevention of leaf scorch. It is impossible, of course, to lay down any general rule; both quantity and frequency of application must depend on the severity of the attack of leaf scorch. This in turn will depend chiefly on the nature of the soil, the frequency of the application of nitrogenous manures, and the root-stocks on which the trees are worked.

Leaf scorch appears to be caused usually by a lack of balance in the soil between the quantities of available nitrogen and available potash. This is likely to occur only in the lighter classes of soils, from medium loams to sands; it is very rare in well-drained heavy soils. Where leaf scorch is present at all, applications of nitrogenous manures, unless accompanied by potash, are almost

certain to make it worse ; the better plan is to withhold nitrogenous manures altogether, and give potash dressings, more generously where the leaf scorch is severe. Our annual applications of 4 cwts. of sulphate of potash per acre to trees many of which were badly, though not exceptionally severely, leaf scorched, was probably not excessive at first, but could very likely have been reduced without loss of returns in the later stages.

The frequency of application must also depend on circumstances. Our trial was not arranged in such a way as to show whether one, or perhaps two, applications would eventually have proved enough for a long period. The fact that, although detailed records showed in several cases a slight effect from the first application, no general striking effect was visible on the plot until after the third application, does *not* prove that three applications were necessary. It is possible that the first one or two applications may not produce their full effects until the third or fourth year, or later.

There is much other evidence, however, to show that, even if nitrogenous manures are withheld altogether, one or two potash applications will not in the long run completely cure severe leaf scorch. Especially where apple trees (practically always bush trees) are worked on one of the semi-dwarfing root-stocks associated with leaf scorch (Improved Doucin, No. V., Doucin, No. II., and the nameless No. VII.) it is extremely probable that frequent applications of potash will be necessary (where it is needed at all) in order to keep leaf scorch permanently in check. They may not be needed every year ; but they should certainly always accompany any application of nitrogenous manures, unless the latter themselves contain potash.

The frequency of severe cases of leaf scorch amongst our trees on seedling or " crab " root-stocks suggests that, where leaf scorch is present at all, such trees also will benefit from frequent applications of potash. A considerable proportion of our trees on " crab " are, of course, only slightly affected by leaf scorch, but all the seven varieties in our trial which are on " crab " stocks show, on the average, very clear evidence of benefit from potash applications.

Whether trees on the varieties of " paradise " root-stocks not specially associated with leaf scorch will show similar benefits, we are unable to say ; but we can safely guess that they will need less frequent and generous applications of potash than trees on the other classes of root-stocks already referred to.

We are frequently asked, also, what form of potash fertiliser is likely to be the best, but unfortunately we cannot as yet give any satisfactory reply. We ourselves have used sulphate of potash, and have found it, as we have shown, very successful. We know of growers who claim equally successful results from the use of muriate of potash, and kainit ; but we have at present no means of testing these claims. There is some slight evidence to suggest that, in certain soils, potash may be somewhat harmful to small fruits, particularly raspberries

and black currants ; and that in such cases sulphate of potash is safer than kainit (we know of no evidence about muriate). But we do not yet know under what (if any) conditions such ill effects occur ; and we may find that they are avoidable by applying the potash only at certain seasons of the year.

Finally, there is the possibility, often worth considering, of controlling leaf scorch by " grassing down " the orchard or plantation where it occurs. It has been known for at least ten years that leaf scorch very rarely, if ever, occurs amongst trees in grass, for the reason, as we now realise, that in such conditions the available nitrogen is much smaller in quantity than in cultivated soil. There are two disadvantages: first that leaf scorch is usually worst in light "droughty" soils which are least suitable for grass orchards, owing to their liability to dry out ; and secondly, that most severe cases of leaf scorch occur amongst bush trees, clearly because most plantations of bush apples consist largely of trees worked on one of the varieties of " paradise " associated with leaf scorch (see above). Yet in certain cases grassing down may prove to be the most economical remedy for leaf scorch.

In our own trial plot where the trees are planted at 14 feet square, and where the soil is a medium loam reasonably retentive of moisture, the " filler " trees of several varieties are now meeting the permanent trees across the rows ; and this happens much more frequently, of course, on the part of the plot treated with potash, owing to the stronger growth of the trees. We must either check the growth of the trees in some way, or else trim up the " fillers," and in a few years remove them altogether. In such a case grassing down, even amongst bush trees, may be the most satisfactory treatment. We should gain in reduced cost of cultivation, longer life for the " filler trees, " no expense for potash manures and almost certainly in more highly coloured fruit. Against this we should have the expense, since the trees are too low headed to allow of feeding the grass off, of frequently mowing the grass during the summer (probably by hand) ; we should also very soon have to begin feeding with nitrogen ; and we should probably get somewhat lighter crops of smaller fruit, particularly in dry years. On balance it might well prove that we should gain more than we lost by grassing down.

RED CURRANT VARIETIES.

By J. AMOS.

It has been shown in the past, especially in the case of Black Currants and Raspberries, that before reliable trials of the comparative economic value of different varieties could be undertaken, a period of time had to be devoted to classification and identification. Further, in view of the fact that many varieties of currants come apparently true from seed when self-pollenated, and are indistinguishable botanically, yet possess very different cropping value, it becomes necessary to propagate from a single plant to insure a true stock. In the case of Red Currants the above procedure has been adhered to at East Malling and a considerable quantity of such material is becoming available for definite comparative trials of the different varieties. Up to the present all observations upon cropping capabilities have been made upon material obtained in commerce, so that there has been no attempt to obtain statistical data of fruit weight from year to year.

It is, therefore, only intended here to give a brief account of the collections of Red Currant varieties obtained, and more particularly the methods used in identifying them. Although a large number of named varieties have been got together, special attention has been paid to the chief varieties grown commercially, and these will be the ones dealt with here as being of special interest to Growers. Hedrick (3) and Thayer (4), list and describe a large number of the lesser known varieties.

The Collections.

The collections have in all cases been obtained from nurserymen in various localities. The idea was to see if a uniform system of nomenclature was common, and to what extent mixtures occurred. On examination it was found that the great majority of varieties received were true to name and unmixed.

A few were, however, mixed; several were apparently wrongly named and not a few were received under several different names. It was also obvious in some cases that local names had been substituted for the original.

On the other hand, a survey of growers' plantations in Kent, revealed a less satisfactory state of affairs. An unmixed plantation was rarely found, many consisting of no less than five distinct varieties, differing in season and economic value, intermixed. Wrong naming under such conditions was naturally common.

The reason for this state of affairs is probably threefold. First, failure to recognise the importance of varietal characteristics or the methods by which to

distinguish them; secondly, indiscriminate "gapping" up in the plantation; and thirdly, propagation from such unrogued material, and the subsequent sale of surplus bushes in local markets.

Origin of Varieties.

Unlike Black Currant varieties, which have been derived from a single species, Red Currants show clearly their descent from at least three distinct species.

The part played by these species is fully dealt with by Mr. E. A. Bunyard in "History and Development of the Red Currant" (1). Fortunately, certain of the characters of one or other of these species are strongly exhibited by many of the varieties. From these characters it is possible to arrange the different varieties into groups. This has been done by Mr. E. A. Bunyard in "A Revision of the Red Currants" (2), in which he distinguishes the different groups and sub-varieties by giving a general description of the whole plant, especially emphasising flower characters. His work has formed the basis of the classification of the collections at East Malling, and from the growth and flower characters combined, varieties have, in the majority of cases, been readily identified.

It is, however, highly desirable that varieties should if possible be identified solely by foliage characters because it is in the nursery cutting beds that roguing operations should take place, and there flowers are not available.

In the absence of flower characters, which are probably the most distinct features, identification in many instances becomes less easy owing to the great variation in the foliage even upon the same plant.

Key to Identification from Leaves.

However, with this idea in view the following key has been drawn up, and has been used successfully during the past season. Many varieties are not included in the key, and in one case it has been impossible to find distinguishing characters between similar but undoubtedly distinct varieties within one group. It is, however, hoped in a later report to make the list more complete and possibly more explicit.

In identifying from foliage characters the basal and terminal leaves should generally be ignored, those from the middle of the shoots being the most typical.

The chief points noted are:

(1) Under surface of leaf, whether densely hairy (woolly), or hairy.

(2) Venation and pose of leaf blade.

(3) Margins, texture, and colour of leaf.

(4) Depth of leaf sinus (base of leaf must be flattened out to decide this point).

Whilst these are the main points reference has in some cases been made to number of veins in the terminal lobe, colour of young wood and habit of growth.

1. Under surface of leaf densely hairy (Woolly) 2

1. Under surface of leaf hairy 3

1. Under surface of leaf not hairy, leaves folded along main ribs, edges upturned, finely rugose, dull green .. .. FERTILITY.

2. Leaves flattish, margins often a little upturned terminal portion of lobes downturned, growth erect .. .. RABY CASTLE.

2. Leaves upturned, i.e., folded along main ribs (furrowed), causing lobes to appear acute, growth spreading .. .. HOUGHTON CASTLE.

2. Leaves much upturned, i.e., cupped, margins finely serrated, and frilled, light yellow green dense erect growth .. .. SCOTCH.

3. Sinus shallow 4

3. Sinus deep. Leaves large, terminal and lateral lobes recurved, coarsely rugose (veined), dull green, veins in terminal lobe four or less .. VERSAILLES and FAY Group.

4. Leaves flattish 5

4. Leaves upturned, i.e., folded along main ribs (not cupped) 6

4. Leaves much upturned, i.e., strongly cupped serrations coarse 8

5. Margins slightly upturned, terminal portion of lobes downturned, petiole long, young wood pinkish .. .. WILSON'S LONG BUNCH.

5. Margins and lobes downturned, leaf held horizontally, young wood green .. .. .. LAXTON'S PERFECTION.

6. Terminals of lobes downturned 7

6. Lobes upturned, long and acute, especially the central lobe, leaves dark green, held erect, young wood red .. .. PRINCE ALBERT.

7. Margins strongly waved, serrations coarse, foliage dense .. .. DUTCH.

7. Margins not waved, serrations intermediate, foliage open .. .. UTRECHT.

8. Leaves thick and harsh, deep dull glaucous green .. .. LA CONSTANTE.

8. Leaves thin, light green .. .. .. SKINNER'S EARLY.

The varieties included in the Key are probably the chief commercial varieties, and are therefore the ones most likely to be met with in bulk. General notes on their behaviour at the Research Station, are given below, together with the chief characters of the species to which they are allied, and under which they are grouped.

1. VARIETIES OF *Ribes rubrum* DESCENT.

Leaves generally very hairy. Flowers bell shaped. No fleshy ring round pistil. Fruit bunch and berry stems held rigid, berries generally held to one side of bunch.

(*a*) *Raby Castle Group.*

Raby Castle (American Red). Vigorous compact growth, late in leafing in spring. Fruit bunch medium length, berries medium, hang late.

Has failed to crop at East Malling.

Houghton Castle (New Red Dutch) (Abundance). Vigorous spreading growth, late in leafing. Fruit bunch medium, berries medium. Mid-season. Has cropped heavily in plantations of Raby Castle even where the latter has failed.

(*b*) *Scotch Group.*

Scotch (Westwick Red). Sturdy compact grower, vigorous. Fruit bunch short. Berries medium clustered to end of bunch, bright colour, heavy cropper.

La Constante (Southwell Red). Vigorous stout sturdy growth, very late to start in spring. Fruit bunch medium, berries medium, but larger than Scotch. Clustered at end of bunch, bright dark red. Very late. Useful on account of its attractive bunch and lateness.

2. Varieties of *Ribes vulgare* Descent.

Ribes vulgare. Leaves not noticeably hairy. Flower, open, flat. Distinct fleshy ring round pistil. Fruit bunch and berry stems not rigid. Berries held loosely, all round bunch.

In addition to the above characters, a section of varieties show in addition, the influence of *Ribes macrocarpa.* These have large thick dull glaucous green leaves. All are large fruited and the shoots which are strong and stout are very liable to be broken out by wind. They also show a tendency to produce blind buds. Versailles and Fay are typical of the Macrocarpa section.

Versailles Group.

Versailles. Growth vigorous and upright not so brittle as some in this class early to start in spring. Fruit bunch medium to long. Berries large, hang loosely, bright red, mid-season.

Fays' Prolific. Growth moderate. Very brittle, early to leaf. Fruit bunch long. Berries large. Berry stems longer than in Versailles, bright red. Early. There are several other varieties in this group, viz. : Cherry, Comet, Wilder. All are however, very similar and difficult to separate.

Dutch Group.

This group shows the characters of *Ribes vulgare,* without the large glaucous green leaves of the *macrocarpa* section.

Dutch. Vigorous upright growth. Fruit bunch long. Berries medium. Berry stems short, held to one side. Mid-season.

Skinner's Early. Similar in growth to Dutch, but earlier. Fruit bunch long. Berries medium. Ripens early. Crops heavily and is grown for its earliness.

Utrecht. Growth moderate, open. Fruit bunch long. Berries medium, bright colour. Early-mid-season, makes a good sample, is not commonly grown, but its long truss and bright fruit recommend it.

Laxton's Perfection. Growth moderate, tendency to go "blind", early in leaf. Fruit bunch very long, berries very large, mid to late. The largest currant in cultivation. Berries have a tendency to darken.

3. Varieties of *Ribes Petræum* Descent.

Large thick smooth almost shiny leaves, deep green. Young wood and petioles deep red. Shoots strong and stout. Very large winter buds. Flower bell shaped on short stems, bunch thick and rigid. Very late in growth.

Prince Albert Group.

Prince Albert (Rivers' Late Red) (Murie Red). Very vigorous grower, makes a large erect bush, very late in leaf. Fruit bunch long, berries medium, pale red. Very late to ripen.

Bushes slow to crop, when young, but worth planting on account of lateness.

4. Varieties outside the Main Groups.

Victoria (Wilson's Long Bunch). Not a strong grower, uneven, late to leaf in spring, Fruit bunch long. Berries medium, pale red. Very late.

Fertility. Vigorous compact growth. The earliest to come into leaf. Fruit bunch very long. Berries small mid-season.

From the collections at East Malling and the survey of growers plantations it is possible to give some idea of the varieties that appear outstanding.

Fay's Prolific appears to be the most popular, probably on account of its long truss of large bright berries, combined with early and even ripening. The tendency of the shoots to break out on young bushes can to a great extent be prevented by planting in sheltered places and tying in of the bushes during the summer months.

Versailles at the Research Station has shown less tendency to "break out" and has given satisfactory crops.

The variety, Skinner's Early is still grown by many, being a heavy cropper and very early in ripening.

Scotch, a sturdy and compact grower is also prominent in many plantations. It is a profuse bearer and the berries are bright and make an attractive sample. The bunches are a little difficult to pick, and the fruit is apt to be small unless the bushes are regularly and severely pruned. A variety that is less grown but has much to recommend it is La Constante. Its fruit truss is of the Scotch Type, but the berries are larger and much later to ripen than that variety.

Wilson's Long Bunch is a useful variety on account of its lateness. The trusses are long and the pale reddish berries make a bright attractive sample. Not a vigorous grower.

Where very late fruit is required Prince Albert is the variety planted. It is rather slow to come into bearing but when mature carries heavy crops. Being very late to ripen it does not clash with the picking of Black Currants as do so many other varieties.

Laxton's Perfection on account of its large fruit and long trusses is a useful variety, especially when once established, making large bushes and producing heavy crops.

A variety of the Dutch Group, viz., Utrecht which does not seem to be commonly grown, has at East Malling shown considerable promise. It is fairly early to ripen, has long trusses of medium sized berries, bright in colour and is very easy to pick.

One other variety, which has in the past been extensively planted is Raby Castle. Recently however, it has in many places failed to crop. The cause of this failure is due to the buds becoming infested with mites, which on examination have been found to be apparently the same species as that damaging Black Currants.

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(1) *Bunyard, E. A.* "The History and Development of the Red Currant." Journal of the Royal Horticultural Society. Vol. XLII., Parts II. and III., p. 260, 1917.

(2) *Bunyard, E. A.* "A Revision of the Red Currants." Gardeners' Chronicle, Vol. LXII., Third series, pp. 205, 217, 232. 1917.

(3) *Hedrick, U. P.* The Small Fruits of New York. New York Agricultural Experiment Station Thirty-third Ann. Rep., Part II., June 30th, 1925.

(4) *Thayer, P.* The Red and White Currants. Bulletin 371. Ohio Agric. Experiment Station. June, 1923.

THE PROPOSED FRUIT SOILS SURVEY IN KENT.

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AND

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(*Reprinted from the "Journal of the Kent Farmers' Union" December*, 1928.)

Nearly thirty years have passed since Sir Daniel Hall, then Principal of Wye College, started to get together the material for the survey which, in collaboration with Sir John Russell, was published under the title of "Soils and Agriculture of Kent, Surrey and Sussex."

A considerable part of this celebrated survey was devoted to horticultural conditions, and a large number of soil analyses were made from soils on which fruit was grown.

Owing, however, to the general nature of a survey, which dealt with all branches of agriculture in three counties, no attempt was made to give more than what the authors themselves describe in their preface as a "preliminary sketch" designed "to demonstrate the possibility of a Soil Survey useful to the Farmer, and indicate the lines on which it can be fruitfully carried out."

Need for Soil Survey.

Since that time, not only has there been a very great increase in the acreage of land under fruit in the county, but certain inevitable changes have taken place in the methods of planting and cultivating.

These altered conditions have come about partly through economic changes and partly as the result of trials and investigations carried out by fruit growers and research workers in various parts of the country.

Since the war there has developed a marked tendency to plant up fruit outside the older fruit areas.

In many cases, these new plantations have prospered under what would once have been considered the most unfavourable conditions, whilst in other cases, for no obvious reason, the trees have behaved quite differently from what was expected of them and have either died out altogether, or have remained stunted and unhealthy.

Simultaneously with this rapid extension of fruit growing into new soil areas, there has arisen a very much larger demand on the part of the fruit grower for an advisory service in matters pertaining to the science of fruit growing.

In this advisory service, the Ministry of Agriculture, Wye College, East Malling Research Station and the Kent Education Committee all play their part, and, as a result of their combined efforts, a large stock of useful information has been built up for the use of fruit growers in the county.

Much has been learnt in the last fifteen years both as to the habits and the diseases of fruit plants, but much still remains obscure, and there is no doubt that there are many questions continually being asked by fruit growers which no advisory service can yet fully answer. Foremost among such questions are those relating to soil conditions, the comparative influences of different soils upon the growth, behaviour and health of fruit trees, and the relation of soil to cultural and manurial treatment.

If information on such subjects as these is to be of any permanent value, it must surely be based upon direct and detailed evidence obtained from the soil itself.

Methods and Objects of Forthcoming Survey.

As far back as 1922 the Ministry of Agriculture and Fisheries established a Fruit Soil Survey Sub-Committee, including representatives of the Horticultural Research Institutions, with Professor B. T. P. Barker as Chairman. The three existing Horticultural Stations were invited to put forward proposals for developing surveys within their areas. Both Long Ashton and Cambridge were in a position to begin operations immediately with the Ministry's financial assistance. The work of Wallace of Long Ashton in the West Midlands, which was the direct result, has fully demonstrated the practical outcome of such a survey. The contact established in the course of such a survey has made possible the practical application of his intensive researches on nutrition, to an extent that would otherwise have been impossible. Take for example his findings upon the cause of leaf-scorch and its amelioration. A similar survey was undertaken in East Anglia under the direction of Dr. L. N. Newman, and is now nearing completion.

Although, at that time, research workers in the south-eastern area were unable to avail themselves of the Ministry's proposal—on the invitation of the Ministry's Sub-Committee—the South-Eastern Agricultural College and the East Malling Research Station have now been able to collaborate in preparing a scheme for a survey, in the first instance, of the Lower Greensand area of Kent, upon which it is proposed to start operations immediately, in the confident expectation of obtaining assistance from the Ministry of Agriculture, who have already made contributions towards the special chemical equipment needed at Wye, and the root excavation work initiated at East Malling during the past season.

Whilst Dr. Goodwin and Mr. Gethin Jones, of Wye, are assuming responsibility for the chemical and geological aspects, the staff at East Malling, with the assistance of the Kent County Horticultural Adviser, Mr. N. B. Bagenal, are undertaking the detailed survey of orchards and plantations from the fruit growing point of view.

Mr. Bagenal, with the sanction of the Kent Education Committee, will utilise his local knowledge by acting as guide, whilst Mr. W. S. Rogers, with Messrs. Appleyard and Bane to assist, will be responsible for the descriptions, mappings, etc., Messrs. Amos, Grubb and Hatton will use their specialist knowledge to study selected examples of small fruit and rootstock behaviour throughout the range of soils under review.

This group of workers will have as their main object an attempt to correlate the various manifestations of good and bad tree behaviour with definite soil variations and changes in cultural condition. It is hoped that the detailed soil and pomological observations, running parallel, will form the basis for future advice upon the suitability of special varieties, rootstocks, cultural and manurial treatments to the different types of soils. Thus it should be possible in future to avoid many of the costly errors of judgment which are so frequently obvious at the present time. Such a survey will provide advisory service in the district with a " standard of comparison " which it has never had before.

To give an idea of what is meant by such a " standard of comparison," let us suppose, for instance, that it were possible, by means of the survey, to discover with a considerable degree of accuracy, certain facts with regard to the behaviour of the apple Worcester Pearmain on the Kentish ragstone soil. If it were known for example what was the acreage of Worcesters between the age of ten and twenty years, their average crop, their stocks, and their susceptibility to diseases such as canker and scab upon the varying types of soil, a very definite standard of comparison would thereby be established for the variety Worcester Pearmain under certain well defined conditions.

Or again in the case of Cox's Orange Pippin, it might be found as a result of such an enquiry that this variety grew and cropped well on the Folkestone Sands, in spite of canker, whereas, on the Kentish ragstone, the damage caused by canker might be found to be so severe as to render the variety unprofitable to grow.

In the course of investigations into the mechanical and chemical composition of these two soils, it is conceivable that the investigators might stumble upon the explanation for the varying behaviour of Cox's Orange Pippin, and thus provide an answer to one of the many questions concerning soil influence which are so often asked, but which have never yet been satisfactorily answered.

Area to be Covered and Reasons for Choice.

The soils of Kent belong to a number of different geological formations, and for this reason alone it will be necessary to extend the survey eventually to include examples of all the different formations.

It has been thought advisable, however, to choose as a starting point, the Lower Greensand formation, i.e., the area between the Gault Clay at the foot of the North Downs and the Kentish Weald Clay. This comprises a long com-

paratively narrow strip running east to west from Westerham to Folkestone, the whole fruit area of which the survey hopes to cover.

In the first place, this formation offers for survey a large acreage of fruit planted and cultivated under strikingly comparable conditions.

In the second place, the Hythe beds (or Kentish ragstone) and the Folkestone sands, the two main divisions of the Lower Greensand, are sufficiently distinct from each other to furnish a wide range of analysis, and, at the same time, they strongly resemble, in their main soil features, other important fruit soils in the county.

Thus, for example, the Folkestone sands have much in common with the Thanet sands, Woolwich beds and Oldhaven beds on which so much of the fruit in the north and west and east of the county is planted, while the Hythe beds or Kentish ragstone bears quite a marked resemblance to the famous Brick earths which are to be found in many parts of Kent.

It will be seen, then, that once the Lower Greensand has been carefully surveyed, a measure of variation will have been set up not only for the sandy soil type, but also for the medium loams. From this point, the next stage is comparatively straightforward and might embrace a survey of the so-called black pebble soils and the brick earths in the North and West and East. After that, perhaps might come the clay formations of the Wealden Plain and of the clay with flints. When a standard of comparison had thus been established for sandy, medium, and clay soils, the survey might fittingly be brought to a close by a study of the Hastings beds in the southern half of the county, where the fertile banks on Tunbridge Wells sandstone and the sticky valleys of Wadhurst clay lie in adjoining fields and offer the analyst every conceivable combination of clay and sand particles.

These are the broad outlines of the scheme, but while it is comparatively easy to make a plan of attack, it is not always so easy to carry it out.

Assistance of Fruit Growers Essential.

The plan outlined above is designed in the service of the fruit grower, to fill certain important gaps in our knowledge of his industry.

If the survey is to be of any value it must be complete, and, in order that it may be complete, it is essential that every scrap of authentic information as to local conditions should be available to those who are making it.

The writers have therefore no hesitation in concluding this article by publicly appealing to all fruit growers in the county, and in the first instance especially upon the Lower Greensand, to help them in this matter, by giving the workers free access to their farms, by answering their questions as fully and as carefully as possible, and by bringing to their notice cases of variation in soil and tree growth likely to be worth investigation.

Part II

Physiology

Part II.

PHYSIOLOGY.

Propagation.

The results obtained at the Station in experiments on vegetative propagation, extending over the whole period of its existence, have been summarised and have been published. Detailed descriptions are given of the various methods which have been used and the results obtained with different varieties are tabulated. The influence of external conditions, and of the nature of the material used, upon the response of the varieties to the different treatments, are also dealt with. A summary appears below.

Routine trials of different methods of propagation by cuttings have been continued during the year.

Influence of Rootstock on Leaf Relations in Apples.

A start has been made upon an investigation of the influence of rootstock upon the leaf relations of scions. Much is known about stock effect upon wood-growth and fruiting, but very little as to its effect on leaf relations. Yet the leaf is one of the most important plant organs, for it is the seat of the process of photosynthesis, whereby the plant fixes, from the CO_2 of the air, practically all the carbon which it requires for growth and fruiting; some nine-tenths of the dry matter in a plant are the products of this process. The amount of carbon fixed depends on the area of leaf surface exposed to light, the proportion of this surface which intercepts only diffuse light and upon the relative intrinsic efficiency of the leaves as photosynthetic organs. It is conceivable that a rootstock may influence the photosynthetic activities of a scion by affecting any of these conditions. Fruitfulness in a tree may depend in part upon the ratio between the amount of carbon fixed and the amount of some mineral absorbed by the roots, and a rootstock may, therefore, influence fruitfulness by its effect on leaf relations.

The investigation will involve work on two distinct lines :—

(1) Morphological observations on the relative amount and distribution of leaf surface on stems of varieties worked on different stocks and on their own roots.

(2) Determinations of the photosynthetic activity of the different leaves.

The morphological aspect of the problem is being attacked first.

METHODS.

Almost all past work on leaf relations has been done on annual plants with relatively few leaves, and methods of leaf measurement developed in such work are not suitable, without modification, for work on fruit trees which have many more leaves. Before launching a large scale investigation on these lines, it has been necessary to develop a technique which will allow large numbers of leaves to be measured rapidly and accurately. Much of the past season has inevitably been spent on this task.

After extended trials, it has been found possible to measure total leaf area of young trees by a method of comparing leaves with " standard forms " of known area—irregular and abnormal leaves being traced and measured by planimeter.

GROWTH.

(*a*) *Stem Diameter and New Shoot Growth.*

Periodical measurements have been made, extending over two seasons ; and including apples and plums, to determine the increase in stem diameter in relation to shoot growth. Trees of different varieties and on different stocks, and also comparable trees subjected to different degrees of pruning, were used and measurements were made at short intervals during the growing season, at several points on stems of different ages. Close correlation was found between the proximity of growing shoots and the amount of diameter increase at any point. A report on this work will be prepared shortly.

(*b*) *Root Thickening and New Shoot Growth.*

The passage of the " wave " of cambial activity from the vicinity of growing shoots, downwards through older stems, which has already been studied, has been followed into the roots, where it travels from the older to the younger portion of each root. Thus, even in young trees, it is often mid-July before new wood appears in some of the longer roots, although the production of new roots has been actively proceeding much earlier in the season.

(*c*) *Stock Influence and Branch Orientation.*

Some observations on the relation between these two have been published. The dominance of the *apical* branch was found to be the main factor in determining relative branch weight. A summary appears below.

PRUNING.

In collaboration with the Pomology section, several series of young trees, including many combinations of stock and scion, were pruned in different ways in the winter of 1926-27, and measurements were made in 1927-28 of the root and stem growth made by the trees. The results confirm those obtained with smaller series of trees in similar experiments in earlier years.

Pruning results in the reduction of total stem growth and of total root growth in the following season, but the distribution of stem growth is different in pruned trees from that in unpruned trees. In the former, new stem growth takes the form more of new shoots and less of increase in size of old shoots, whilst in unpruned trees, new shoots are reduced to a minimum and new growth takes the form of thickening of older stems. The relation between the amount of total new stem growth and total new root growth is unaffected by pruning—a reduction of the former being accompanied by a corresponding reduction of the latter. A report on this work is in preparation.

Excavation of Root Systems.

In collaboration with the Pomology section, a quantitative examination has been made of the root systems of some ten year old trees of Lane's Prince Albert on stocks Nos. I. and IX. The results to date have been published and a summary appears on p. 44.

PUBLICATIONS DURING THE YEAR.

(1) *Knight, R. C., Amos, J., Hatton, R. G.,* and *Witt, A. W.* The Vegetative Propagation of Fruit-Tree Rootstocks. East Malling Res. Sta. Ann. Rep. for 1926-27 (Oct. 1928), (II. Supplement), 11-30.

Summary.

Concurrently with the experiments upon rootstock influence on scion, a series of trials have been carried out to determine the best methods of multiplying the fruit tree rootstock by vegetative methods, in order to ensure the perpetuation of races with known characteristics.

Detailed descriptions are given of the various methods which have been used and of the manner in which different varieties respond to them, together with some account of the influence of external conditions and of the inherent properties of the material in determining this response.

Tables show the actual numbers of individuals of the different varieties which have been obtained in a series of trials extending over twelve years.

An appendix indicates which of these methods has been most consistently successful with each of the varieties tested.

(2) *Knight, R. C.* A Note on the Orientation of Main Branches and Its Relation to Stock in Some "Double-Stock" Apple Trees. East Malling Res. Sta. Ann. Rep. for 1926-27 (Oct. 1928), (II. Supplement), 56-59.

Summary.

In a series of trees, each of which was grafted on two stocks (one on each side of the scion) of different vigour, the largest branches were not necessarily those on the side of the strongest root-stock, but were those emerging from the highest points on the main stem.

Part III

Biochemistry

Part III.

BIOCHEMISTRY.

Stock Influence.

The importance of the mutual effects of rootstock and scion is now well known and many of the scientifically obtained facts have been utilised in practical horticulture. Consideration of these facts has suggested that an explanation of them in physiological or biochemical terms might well lead to even more confident and extended practical applications in the future.

In view of the complicated relationship which is known to exist between rootstock and scion a decision as to the best point at which to make a biochemical attack is a difficult one. It is known that relatively simple inorganic salts are absorbed through the roots from the soil and pass thence to the various parts of the plant, of which they constitute the main bulk of the ash, and that in the leaves these inorganic salts and carbon dioxide from the air are used to build up the complex organic substances which are distributed thence to the whole plant and of which they make up the main bulk of the dry matter. It is unlikely that our conceptions of the mutual influences of rootstock and scion will be at all complete until both these classes of substances are considered, but it has been decided to study the inorganic ash constituents first.

A preliminary survey of the problem by a spectographic method has shown that the ashes of apple trees grown at the Research Station contain, at least, eleven elements in minute but varying amounts in addition to those which make up the bulk of the ash and which are commonly added in the form of artificial manures. Lead, for instance, seems to be confined to the roots in young trees whereas silver is uniformly distributed throughout the whole plant. Some of these elements (e.g. iron and manganese) which occur in minute quantities are known to be of equal importance to those which occur in infinitely larger amounts. The first aim, therefore, is to carry out as complete analyses of apple tree ashes as possible. It is hoped that these analyses may lead to a decision as to which of the above large number of elements play any important part in the life of the tree. The next step would be to determine what part each plays and whether any practical advantage could be taken of these facts.

At present suitable methods are being sought for the difficult analytical problems presented.

Insecticidal Action of Sulphur.

In collaboration with the Entomology Section fresh facts bearing on the modes of insecticidal action of sulphur are being obtained.

Part IV

Plant Pathology
Mycology and Bacteriology

Part IV.

PLANT PATHOLOGY.

MYCOLOGY AND BACTERIOLOGY.

1. Crown Gall.

Further series of inoculation experiments have been carried out with strains of the Crown-gall organism isolated from a Dock and from a Raspberry stem. Each of the two strains caused galls to develop when inoculated into raspberry canes and into stems of young trees of the apple stock Type VII.

2. Brown Rot Diseases.

Inoculations have been made on pear flowers with strains of *Sclerotinia cinerea* isolated from cherry and plum with the object of determining whether the fungus on these hosts is able to induce Pear Blossom Wilt. A strain isolated from a plum twig readily infected pear flowers and produced typical blossom wilt. Two strains from cherries gave inconclusive results and the experiments will be repeated.

3. Effect of Root Stock on the Susceptibility of the Scion.

Observations taken on the trial plot of Cox's Orange Pippin on various types of stock confirm in general the results obtained in previous years, that the degree of infection by Apple Scab and Apple Mildew is influenced to some extent by the rootstock. The difference in most cases is slight. The most striking instances are afforded by the trees on Type I. and those on Type XVI. (in 1927 as in 1926 the trees on the former rootstock had appreciably more mildew than those on the latter), and by those on Type V. and on Type XIII.,—the former in both years, showing greater susceptibility to scab than the latter.

4. The Pathology of the Raspberry and Loganberry.

(1) *Blue Stripe Wilt.*

An attempt was made to induce the infection of seedling raspberry plants through the uninjured root system by germinating the seeds in soil previously infected with *Verticillium Dahliæ.* The results of this experiment were inconclusive owing to the small percentage germination of the seeds but were sufficiently suggestive to warrant a repetition.

(2) *Cane and Leaf Spot (Anthracnose) of Raspberry and Loganberry.*

(*a*) *Raspberry Cane Spot.*

A further spraying trial was carried out against the disease using Lime Sulphur (two applications at 1:10 and 1:40 strengths respectively) and

Bordeaux Mixture (two applications at 12:12:100 and 6:6:100 strengths respectively), and has again given a very satisfactory control.

An experiment to determine the degree of control obtained by cutting out the fruiting canes and burning them, immediately after the removal of the fruit crop, was carried out in conjunction with the spraying trial. Results of this experiment are not yet available. A spraying trial was also carried out in a badly attacked plantation of Reader's Perfection, using Bordeaux Mixture, and gave a good control of the disease.

(*b*) *Loganberry Spot.*

Of late, this disease, which is caused by a fungus apparently identical with *Plectodiscella veneta*, has caused great damage in the loganberry plantations in the Kentish Weald.

Preliminary experiments in the control of the disease by spraying, using Bordeaux Mixture and Lime Sulphur, were carried out on the plantation of two growers in the Brenchley district and gave very promising results.

(3) *Raspberry Mosaic.*

(*a*) *Methods of Artificial Transmission.*

An experiment, in extension of the previous year's work on transmission by grafting, was carried out with the objects (1) of improving the technique of the grafting so as to obtain a higher percentage of " takes " and (2) of finding whether " mosaic " symptoms of varieties other than *Baumforth Seedling B* could be transmitted by this method from diseased scions to healthy stocks, using *Baumforth Seedling B* and *Lloyd George* as stocks. These experiments have given positive results. An attempt was also made to transmit the disease by the method of " bark grafting " by which method no wood or bud is transferred from the diseased plant to the healthy stock plant. Up to the time of leaf fall, transmission was shown in the case of two of the plants grafted by this method.

(*b*) *Field Experiments.*

(i) A plot has been planned with the object of isolating and keeping under observation selected plants of certain varieties showing more than one type of leaf symptom.

(ii) A plot has been planned with the object of raising mosaic-free stools for experimental purposes.

(iii) An experiment has been started on a young plantation of *Lloyd George* to determine the possibility of controlling the disease by a systematic " roguing " of diseased stools.

(4) *Spur Blight.*

A confirmatory inoculation of canes with pure cultures of *Didymolla applanata*, isolated from stems and leaves of diseased canes was made and gave positive results.

A preliminary attempt to control the disease by spraying was carried out on a badly attacked plantation of Reader's Perfection, but the results of this experiment are not yet available.

(5) *Experiments with other fungi associated with diseased raspberry canes.*

During the year two fungi have been found in association with diseased canes and have been isolated. One of these organisms appears to be identical with *Cryptosporium minimum*, a parasite of Rambler Roses, the other corresponds closely with descriptions of *Microthyriella rubi*. Inoculation experiments with these fungi have given positive results. It is very doubtful, however, whether either of these organisms causes any considerable damage to infected canes.

5. Bacteriosis of Plum and Cherry Trees.

Further cultural and inoculation experiments have been made on the organisms associated with

(1) Bacterial Shoot Wilt of Plum trees.
(2) Gummosis and Leaf Spot of Cherry trees.
(3) Bacterial Canker of Plum trees.

Attention has been especially directed towards the last named, particularly as serious outbreaks in Kent and other counties occurred in 1928.

Work has been carried out during the year

(*a*) To ascertain whether the disease occurring in other districts is caused by the same organism which has been found producing Bacterial Canker at East Malling.

(*b*) To determine the time of year when infection of the stem most readily occurs.

(*c*) To test the value of spraying in controlling the disease.

6. Two Wilt Diseases.

(1) *Hop Wilt.*

A further inoculation of healthy hop sets with pure cultures of *Verticillium albo-atrum* Rke. and Berth., isolated from diseased hop hills, has yielded positive results, which finally demonstrate the parasitic nature of the organism.

Records taken from the field trial on the control of the disease by cultural methods show negative results but provide evidence that the severity of the attack of the disease varies greatly from season to season and is closely related to soil conditions such as moisure content, temperature, etc.

A suspected outbreak of the disease in a Herefordshire hop yard was investigated and evidence is forthcoming that the disease in question is identical with that occurring in Kent. A species of *Verticillium* was isolated which closely resembles the species causing the disease in Kent.

(2) *Rhubarb Wilt.*

In the season of 1927 a serious disease in Rhubarb plantations in the neighbourhood of Sandwich, Kent, was investigated. The symptoms were found to correspond closely with those of Verticillium diseases of other crops and a species of *Verticillium* has been regularly isolated from diseased crowns. This year a number of seedling rhubarb plants were inoculated with this fungus and definite evidence was obtained that it is the cause of the disease in question.

7. Walnut Bacteriosis.

Bacterial "Blight" previously noted as infecting the leaves of young walnut trees on this Station, has been observed on the young green fruits of a tree growing in the greenhouse. A yellow organism, resembling that obtained from leaf-spots, was isolated from a fruit spot and its parasitism was proved by inoculation experiments on walnut shoots.

8. Apple Spraying Field Trials.

The spraying trials against Apple Scab and Apple Mildew have been continued on the plot of Cox's Orange Pippin and Stirling Castle. Observations on spray injury have been extended to include trees on the "Variety Trial Plot."

The crop of fruit on the spraying trial plot was again too small to render reliable the data obtained regarding the degree of fruit-infection by Scab. The data collected during 1928 relating to the degree of infection by Scab and mildew on the twigs, by Scab on the leaves, and of spray injury, afford the following indications :—

Apple Scab on Twigs (1928).

A pre-blossom application of Bordeaux Mixture and of Lime-Sulphur on Cox's Orange Pippin, when not followed up by post-blossom spraying, gave no appreciable measure of control. Two post-blossom sprayings of Bordeaux Mixture (8-25-100) and Lime-Sulphur (1-100) gave distinct control, while Colloidal Sulphur (4 lbs. to 100 gallons) and Lime-Sulphur (1-150) have also shown reduction of infection.

Apple Scab on Leaves (1928).

Lime-Sulphur (1-30) has shown a lasting beneficial effect when applied before blossoming. Post-blossom applications of Bordeaux Mixture (8-25-100) and Lime-Sulphur (1-100) have reduced infection, the former being the better fungicide. One application of Bordeaux Mixture (8-8-100) before blossoming, followed by two applications (each at 8-25-100) after blossoming, have shown almost complete control. Lime-Sulphur (1-150) and Colloidal Sulphur (4 lbs. to 100 gallons) were of little use in controlling infection.

Apple Mildew on Twigs (1927).

Pre-blossom spraying only, with Bordeaux Mixture and Lime-Sulphur on Cox's Orange Pippin, and with Lime-Sulphur and Ammonium polysulphide (1-100) on Stirling Castle, gave no marked indication of control. When two post-blossom applications were given, either alone or with the addition of a pre-blossom application, Lime-Sulphur in every case has given better results on these varieties than any other sprays tested. The results obtained in 1927, when compared with those of 1926 (when none of the sprays used noticeably reduced infection) show the cumulative effect of spraying.

Spray Injury (1928).

Bordeaux Mixture again caused injury to the leaves of Cox's Orange Pippin, but it was comparatively less conspicuous after blossoming than during the summer of 1927, when more rain fell.

The same spray also caused a reduction of fruit set, and a fruit drop, on this variety, when applied before and after blossoming. Lime-Sulphur showed a similar result on Stirling Castle.

Fruit russetting was also caused on Cox's Orange Pippin by Bordeaux Mixture applied before and after blossoming.

Stirling Castle again suffered severe leaf-fall by the application of sulphur-containing sprays after blossoming. The cumulative effect of three years' spraying is now strikingly shown in the field by the stunted growth of the trees.

9. Blister Canker of Apples.

Following on results of the spraying trials, observations for spray injury were made on a number of varieties of apples (which had been sprayed with Bordeaux Mixture) on the Station. In some cases severe russetting, together with cracking, was found on the fruit. On the damaged areas there was invariably present a fungus, which, from its morphology and the type of injury produced, appears to be the Blister Canker fungus (*Coniothecium chomatosporum*) which has been described as causing severe injury to apples in New Zealand and South Africa. It was later found that unsprayed fruit showed similar injury and bore the same fungus, so the inference is that the damage, at first thought to be spray injury, is probably caused by a parasitic organism. Further observations are being made on this type of injury, which has obviously a fundamental importance in relation to spraying experiments.

PUBLICATIONS DURING THE YEAR.

Harris, R. V. Raspberry Cane Spot and its Control. East Malling Research Station, Ann. Rep. 1927 (May, 1928), (I General), 57-63.

Summary.

The control measures recommended are :—

A. The New Plantation.
   1. Avoid planting up very susceptible varieties.
   2. If a very susceptible variety such as *Baumforth Seedling B* is selected or if the canes for planting show any trace of spotting, cut all the cane back as hard as possible directly after planting, and burn the canes thus cut away.

B. The Established Plantation.
   1. Cut out and burn all the most badly cankered and spotted canes during the spring thinning of the stools.
   2. Spray with Lime Sulphur (a delayed dormant application at 1 in 10 and a pre-blossom application at 1 in 40).
   3. Cut out and burn, as soon after cropping as possible, all the old fruiting canes.

Wormald, H. The Parasitism of the Hop Leaf-spot fungus *Cercospora cantuariensis*. Trans. Brit. Mycol. Soc., 1928, **13,** 32-39.

Summary.

Inoculation experiments have shown that the fungus, *C. cantuariensis,* found in 1922 associated with a leaf-spot of hop plants in a commercial hop garden at Canterbury, is the primary cause of the disease. Under experimental conditions infection could be induced by means of inoculations with mycelium from plate cultures or with conidia from infection spots. Conidia, placed on leaves of hop plants in moist air, infected the leaves directly and typical spots appeared within a few days. Severe infection sometimes caused premature leaf-fall.

Wormald, H. Further Studies of the Brown Rot Fungi III., Nomenclature of the American Fungi : A Review of Literature, and Critical Remarks. Trans. Brit. Mycol. Soc., 1928, **13,** 194-204.

Summary.

A survey is presented of the literature on the nomenclature of the brown-rot fungus generally distributed throughout the fruit-growing regions of the United States and Canada. The names that have been applied to it are : *Sclerotinia fructigena* (Pers.) Schröt. ; *Sclerotinia cinerea* (Bon.) Schröt. ; *Sclerotinia cinerea* forma *americana* Wormald ; *Sclerotinia americana* (Wormald) Norton and Ezekiel ; *Sclerotinia fructicola* (Winter) Rehm.

The fungus is undoubtedly more nearly related to *S. cinerea* than to *S. fructigena* which is not known in North America.

The results of cultural work, and of field observations on the injury caused by this fungus and by *S. cinerea*, are now generally accepted as sufficient evidence for considering them as distinct species.

The main theme of the paper is to show that descriptions of Winter's *S. fructicola* do not differentiate between *S. cinerea* and Norton and Ezekiel's *S. americana* both of which are found in North America.

In the present state of our knowledge, therefore, the author prefers the name *Sclerotinia americana* for the more common brown-rot fungus of America.

Wormald, H. The Present Distribution of the Brown Rot Fungi : Its Economic Significance. Jour. Min. Agric., 1928, **35,** 741-750.

SUMMARY.

(1) The chief fruit-rotting fungus of Britain and the Continent of Europe (*Sclerotinia fructigena*) has not been found in Australia, New Zealand, and North America.

(2) The Blossom Wilt fungus of plums and cherries (*S. cinerea* forma *pruni*) also common in Europe, is found in the Pacific coastal regions of North America but not in Australia or New Zealand.

(3) The Blossom Wilt fungus of apples (*S. cinerea* forma *mali*) appears to be confined to Europe.

(4) The Brown Rot fungus prevailing in North America, Australia, and New Zealand (*S. americana*) is not at present found on fruit trees in this country, but it has been found recently on peaches imported from America.

(5) The possibility and consequences of introducing any one of these fungi into a region where it is not found at present are discussed.

Wormald, H. On the cause of " die-back " in plum trees. Gardeners' Chron., 1928, **84**, 372-373.

SUMMARY.

The symptoms of this disease, as shown by trees on the trial plots at the East Malling Research Station, are stunted growth and yellowish foliage, followed by the death of the tree or branches. These symptoms are accompanied by bacterial lesions on the stems or branches. An organism isolated from such lesions proved by inoculation experiments to be pathogenic. The name Bacterial Canker is proposed for this type of " die-back."

There is evidence that the same organism causes a spotting and " shot-holes " in the leaves.

Wormald, H. Notes on Plant Diseases in 1926. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 75-88.

SUMMARY.

The chief features noted are the prevalence of Gray Mould (*Botrytis cinerea*) on various hosts, and the damage caused by Blossom Wilts (*Sclerotinia cinerea*) particularly on Morello cherries. Brown Rot of apples (caused by *Sclerotinia fructigena*) was common about picking time, particularly on those James Grieve apples which had been picked from the stalks instead of with the stalks, the rot starting at the stalk end.

Hatton, R. G., H. Wormald and A. W. Witt. Burr-knots. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 89-91.

SUMMARY.

This is a resumé of a more detailed paper which appeared in the Jour. of Pomology, 1926, **5.**, 195-204. Observations and experiments show that burr-knots are not a pathological condition and that they are not a form of crown-gall.

Wormald, H. Canker in Fertility Pear Trees. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement).

SUMMARY.

Severe damage caused by the canker fungus (*Nectria galligena*) infecting through scab lesions was noted on standard Fertility pear trees, while on bush trees of the same variety the damage was relatively slight. It is advised that this variety be grown as regularly pruned bush trees rather than as standards, since the pruning operations tend to reduce infection by removing scab infested wood, and on bush trees spraying against scab can be more effectively carried out than on standard trees.

Frampton, A. M. Preliminary Report on the Incidence and Control of Apple Scab and Apple Mildew. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 96-107.

SUMMARY.

This is a report on one year's work, carried out in 1926, in connection with Spraying Trials that are being carried out at East Malling Research Station, on trees of the varieties Cox's Orange Pippin and Stirling Castle. The chief results recorded are:

On Cox's Orange Pippin scab was controlled on the foliage for seven weeks by a pre-blossoming application of either lime-sulphur 1 : 29, or Bordeaux Mixture 8-8-100. A further application after blossoming of lime-sulphur 1 : 100 or of Bordeaux Mixture 8-25-100 proved similarly fungicidal. The post-blossoming application of both lime-

sulphur and Bordeaux Mixture caused considerable dropping of the older leaves.

On Stirling Castle post-blossoming application of sulphur-containing sprays caused some defoliation.

Wormald, H. and *Frampton, A. M.* Note on "Black Rot" of Cruciferous Plants. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 108-110.

SUMMARY.

In October, 1925, seedling plants of broccoli and savoy on the Station showed symptoms similar to those described for Black Rot, a disease of cruciferous plants which is common in America.

From diseased leaves an organism was isolated which was found to correspond to *Pseudomonas campestris* the bacterium which causes Black Rot. A brief description of symptoms and suggestions for control are given.

Wormald, H. Notes on Plant Diseases in 1927. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 111-118.

SUMMARY.

Of the diseases mentioned in these "Notes" the most notable were, the damage caused by frosts in Spring, the Sooty Blotch of apples which was unusually prevalent in 1927, and the severe infection of hops by Downy Mildew.

Wormald, H. Brown Rot of Apples: The need for careful Picking and Storing. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 119-120.

SUMMARY.

This article, reprinted from the Journal of the Ministry of Agriculture, describes the infection, by the Brown Rot fungus, *Sclerotinia fructigena*, of apples (var. James Grieve) through wounds made when the fruit is picked *from* the stalk instead of *with* the stalk. The observations recorded emphasize the importance of taking care to avoid causing injuries, which might allow the entry of the Brown Rot fungus, during the operations of picking, grading and packing.

Wormald, H. Bacterial Diseases of Stone Fruit Trees in Britain, I. Preliminary Note on Bacteriosis in Plum and Cherry Trees. East Malling Res. Sta. Ann. Rep. for 1926-7 (Oct., 1928) (II., Supplement), 121-127.

SUMMARY.

Descriptions are given of certain bacterial diseases of plum and cherry trees in this country. Experiments have shown that bacteria may cause:

(1) Shoot Wilt of plum trees.

(2) Gummosis and Leaf Spot in cherry trees.

(3) Bacterial Canker in plum and cherry trees.

The relation between so-called "Die-back" of stone-fruit trees, and the disease here described as "Bacterial Canker" is briefly discussed.

Harris, R. V. The Pathology of the Raspberry: A Summary of Results of Recent Research at East Malling. East Malling Res. Stn. Ann. Rep. for 1926-7 (Oct., 1928) (II. Supplement), 128-134.

SUMMARY.

This article is a summary of the results of three years' work on four diseases of the raspberry, viz.:

(1) Blue Stripe Wilt (*Verticillium Dahliæ*).

(2) Cane Spot (*Plectodiscella veneta*).

(3) Mosaic.

(4) Spur Blight (*Didymella applanata*).

The symptoms, cause, and suggested methods for control are given for each disease.

Part V

Plant Pathology
Entomology

Part V

PLANT PATHOLOGY.

ENTOMOLOGY.

Dormant Winter Washes.

Red Spider Trials.

It has been demonstrated at East Malling and elsewhere that the tar-distillate dormant winter washes are not toxic to the winter eggs of the Fruit Tree Red Spider (*Oligonychus ulmi* C. L. Koch). In fact it has been shown that an increase of the numbers of red spiders occurs upon the trees where tar-distillate is applied to the same orchard two or more years running.

Experiments upon the control of the red spider have been continued, in collaboration with Dr. Goodwin of the S.E.A. College, Wye. Nine proprietary (winter, egg-destroying) washes were included, and also an oil spray of known composition.

The results of these trials may be summarised as follows:—Four of the proprietary brands were shown to kill from 60 to 68 per cent. of the viable eggs, but two of these sprays caused severe bud injury, while a third did not control aphis or caterpillar. The other four proprietary washes killed only from 1 to 10 per cent., and the oil spray of declared consistency destroyed 50 per cent. of the eggs.

In co-operation with the Bio-chemical Section, preliminary investigations on the control of red spider have been undertaken in the laboratory. A study of the mode of action of sulphur in killing the mite has led to a notable increase in efficiency of the sulphur when tested by a new method in the laboratory. The results are encouraging, but further tests will be necessary before the trials are conducted in the field.

Certain aspects of the life-cycle of the red spider have been studied, and it has been ascertained that a period occurs in the spring when eggs are not present, or present only in limited numbers. It is during this period that the well known sulphur and liver-of-sulphur sprays should be applied to the trees for spider control.

Resistance of Different Varieties to Certain Insect Attacks.

Work upon the relative susceptibility of cherry root stocks to Cherry Black Fly (*Myzus cerasi* Fabr.) has been in progress for several years, and it has been ascertained that some stocks show a high degree of resistance, while others prove to be very susceptible. These investigations have been extended, and

a wider range of stocks, including certain varieties of sour cherries, have been tested in the field.

The results obtained this year emphasise the necessity of repeating the trials for a number of seasons, before definite conclusions can be formed. This season, all the stocks, including the varieties resistant in the previous year, and also the sour cherry stocks, proved to be susceptible to Aphis after the initial inoculation.

Woolly Aphis Inoculation Trials.

These investigations have been confined to a number of the seedlings raised by Mr. Crane of The John Innes Institution—Northern Spy crossed Doucin (No. II.)—which had already been shown to be immune or very resistant to aphis attack. After continued inoculations, made during the summer months, three of these seedlings have maintained their immunity, while two others are shown to be highly resistant.

Apple Sawfly.

The experiments in relation to the control of the Apple Sawfly have now terminated, and a detailed report will be issued elsewhere.

The trials were continued on similar lines to those of 1927, and the results hitherto obtained are confirmed. The period during which the spray can be applied successfully is a very limited one. It has also been ascertained that the spray can be applied in conjunction with one of the normal post blossom fungicidal sprayings.

Further details of the life-cycle have been obtained.

Systematic Study of Gall Mites.

The general systematic work on the group Eriophyidæ is being continued, and several new and interesting species have been found in this country. Four new species have been described, including one on the black currant which has been named *Oxypleurites neglectus* Mass.

Two species of Gall Mites have been found on Lilac both of which are new to Britain. The commoner of these mites (*Eriophyes lōwi* Nal.) lives and feeds in the buds of the one year growths, causing a malformation of the buds, which dry up. The second species (*Phyllocoptes massalongoi* Nal.) attacks the developing flowers buds, the flowers and subsequently the fruits. No normal flowers are produced on plants badly infested by this mite.

Certain characteristics of the free living species of black currant Gall Mite (*Phyllocoptes masseei* Nal.) are being studied, and after three seasons work, a method of technique has been found which makes possible the transfer

of this mite from bush to bush at will. Inoculation experiments will be conducted next season.

The incidence of the Black Currant Gall Mite on red currants appears to be more serious each year, and this season it has been recorded upon five well known varieties. Observations show that the mite of red currants may be a variety of the black currant species, since it has not been possible to induce the mites from red currants to colonise black currants after inoculation. This line of investigation is being followed up.

Raspberry Beetle Investigations.

A study of the life history of the Raspberry and Loganberry Beetle (*Byturus tomentosus* Fabr.) was begun in August, 1927, with a view to obtaining information which would lead to the production of satisfactory control measures. Some light has been thrown on certain obscure points in the insect's life-history, and one or two new facts have been discovered. Preliminary experiments on the control of the pest have been carried out on a small scale.

The Insect Transmission of Rasbperry Mosaic.

A systematic survey of the insect and allied fauna of the raspberry plant has been in progress since August, 1927, with a view to discovering likely insect vectors of the virus disease, Raspberry Mosaic. Transmission experiments are being carried out with certain of the insects observed, and several improvements have been made on the technique employed in previous years in similar experiments.

Other Raspberry Pests.

In so far as opportunity has permitted, observations have been carried out on other raspberry insects, viz.: the Raspberry Moth (*Incurvaria* (*Lampronia*) *rubiella* Bjerk.), the Raspberry Cane Midge (*Thomasiniana theobaldi* Barnes), and certain other insects of minor importance.

PUBLICATIONS DURING THE YEAR.

Massee, A. M. The Life-History of the Black Currant Gall Mite, *Eriophyes ribis* (Westw.) Nal. Bull. Ento. Res., 1928, 18, 297-309.

Summary.

An extensive summary is given of the observations of previous workers on the bionomics of this mite. The mites enter the newly formed buds towards the end of May or June. In an average season swollen buds are seen by third week in August. Spring migration from the big-buds reaches its height at end of April or in May.

Eggs are present all the year round. They may be deposited on the shoots, blossoms or leaves.

Experiments proved that they do not pass any period of their life-cycle in the soil.

During the migration period the mites are carried about by various insects, including Ladybirds.

The chief natural enemy is the Chelcid parasite, *Tetrastichus eriophyes* Taylor.

Host plants: Black currant, red and white currant, gooseberry and the American flowering currant.

Massee, A. M. Winter Washes: Modern Developments in Their Use. East Malling Res. Sta. Ann. Rep. for 1927 (May, 1928) (I. General), 70-78.

Summary.

The uses of the older winter washes, Caustic Soda, Hot-Lime, and Lime Sulphur, are discussed—and the development of the use of the two latter as delayed dormant sprays is emphasised.

The use and effect of the true egg-killing washes—the tar-distillates—in the dormant season is described and a number of recommendations made. Attention is drawn also to the existence of other substances now known to possess egg-killing properties, i.e., Dinitro-o-cresol and its salts.

Massee, A. M. Note on Apple Capsid. Gardeners' Chron., 1928, **83** (3rd Series) 399-400.

Summary.

The date of hatching of the apple capsid bug (*Plesiocoris rugicollis* Fall.) is recorded. In the Swanley District, Capsids were seen to emerge from their eggs up to the 4th May, but it is considered that hatching had not finished at that date.

Massee, A. M and *Steer, W.* Capsid Bugs: Some Interesting Observations. Gardeners' Chron., 1928, **84** (3rd Series), 154, 2 figs.

Summary.

Observations on the oviposition of the Potato Capsid Bug, *Calocoris norvegicus* Gmel. (*bipunctatus* Fabr.) are described. The capsid was observed to lay eggs, often at the rate of sixty to seventy an hour, in old chestnut wood used as fencing. The method of oviposition and the egg are described. Diagrams are given of the ovipositor (x 62) and the egg (x 71·4) of *C. bipunctatus*. (The magnifications as they appear in the legends to the diagrams are incorrect.)

Massee, A. M. and *Steer, W.* The Oviposition of *Calocoris bipunctatus* Fabr. Ento. Monthly Magazine, 1928, **64**, 207-208.

SUMMARY.

This is a record and description of the oviposition of the Capsid *Calocoris norvegicus* Gmel. (*bipunctatus* Fabr.) in old chestnut fencing at the East Malling Research Station, Kent.

Steer, W. *Dicyphus errans* Wolff and other *Capsidæ* on Potatoes in Kent. Ento. Monthly Magazine, 1928, **64**, 236-237.

SUMMARY.

This is a record of the potato as a host plant of the Capsid *Dicyphus errans* Wolff in Kent.

Other Capsidæ found commonly in the nymphal stages on potatoes during 1928 were *Lygus pratensis* L. and *L. pabulinus* L. The latter, a bad pest of red and black currants, gooseberries, etc., has a summer generation on potatoes and various weeds. It was found at the East Malling Research Station that the hop is also an important summer host of *L. pabulinus*.

Massee, A. M., Steer, W., and *Goodwin, W.* Further Experiments with Tar Distillate Washes. East Malling Res. Sta. Ann. Rep. for 1926 and 1927 (Oct., 1928) (II. Supplement), 137-150, 3 figs.

SUMMARY.

Experiments with tar-distillate washes carried out at East Malling Research Station in 1926 and 1927 are described.

Attention is called to certain improvements in technique and in the methods of obtaining adequate supplies of material (i.e., eggs).

The experiments showed:

1. That the percentage of viable eggs of the Vapourer Moth (*Notolophus antiquus* L.) killed by a tar-distillate wash ("Standard B") rises with the concentration of the wash. The 5 per cent. concentration did not, as in the 1925 experiment, give a disproportionately high kill.

2. That in the comparison of a standardised tar-distillate ("Standard B") with a proprietary preparation, used at equal strengths, the former killed 83 per cent. and the latter 69 per cent. of the viable eggs of the Vapourer Moth.

3. That two tar-distillates, one containing low boiling tar acids and the other high boiling tar acids, gave almost identical kills when tested on eggs on the Vapourer Moth, the first preparation giving an average kill of 90 per cent., and the second 94 per cent. of the viable eggs.

4. That a standardised tar-distillate ("Standard A") at 10 per cent. killed 93 per cent. of the viable eggs of the Vapourer Moth.

5. That tar-distillate preparations, dichlorbenzene, and mixtures of tar-distillates and dichlorbenzene, were all ineffective against the eggs of the Fruit-Tree Red Spider (*Oligonychus ulmi* C. L. Koch) at the strengths used.

6. That the two standardised tar-distillate washes ("Standard A" and "Standard B") were only moderately toxic to eggs of the Lackey Moth (*Clissiocampa neustria* L.) under the conditions described, the percentages of viable eggs killed by these washes being 56.5 and 68 respectively.

7. That a tar-distillate wash ("Standard A") was not toxic to the Black Currant Gall Mite (*Eriophyes ribis* (Westw.) Nal.) when used *as a winter wash* and at a concentration of 10 per cent.

Massee, A. M. The Black Currant Gall Mite on Red Currants. East Malling Res. Sta. Ann. Rep. for 1926 and 1927 (Oct., 1928) (II. Supplement), 151-152.

SUMMARY.

The Black Currant Gall Mite is recorded upon red currants. Symptoms of the disease are described, and means of detecting the disease in the field are discussed.

Reference is made to the habits of the mite and the varieties of red currants more frequently attacked.

Le Pelley, R. H. Note on the Use of Tar Distillate Spraying and of Grease-banding against the Woolly Aphis of Apple (*Eriosoma lanigerum* Hausm.) East Malling Res. Sta. Ann. Rep. for 1926 and 1927 (Oct., 1928) (II. Supplement), 153-156.

SUMMARY.

The following points appear from the tests and discussion :—

1. The efficacy of grease-banding as a control measure for Woolly Aphis seems to be limited by the fact that the insect can usually overwinter above ground in this country and that it is very difficult to ensure the destruction of all these overwintering insects ; and by the difficulty of applying the bands in commercial practice (especially on old trees or trees with a rough bark) sufficiently soundly to prevent a small number of insects from finding a way up.

2. Tar-distillate spraying for the specific object of controlling Woolly Aphis would not usually be an economical measure.

3. In addition to its other uses a tar-distillate wash destroys a large proportion of the Woolly Aphis hibernating above ground, and this should be taken into account when assessing the general value of tar-distillate spraying. Its application should considerably decrease the labour of "hand-painting" the colonies of the insect where this palliative measure is employed.

Massee, A. M. Notes on Insect Pests for the Years, 1926-27. East Malling Res. Stn. Ann. Rep. for 1926 and 1927 (Oct., 1928) (II. Supplement), 157-162.

SUMMARY.

The following insect pests are discussed in this report.

The Apple Bud Weevil (*Anthonomous cinctus* Koll.) ; the Pear and Cherry Slugworm (*Eriocampa limicina* Cam.) ; the Apple Mite (*Phyllocoptes schlechtendali* Nal.) ; the Lilac Mites (*Eriophyes löwi* Nal. and *Phyllocoptes massalongoi* Nal.) ; Capsid Bugs *Lygus pratensis, Plesiocoris rugicollis* and *Lygus pabulinus ;* the Fruit Tree Red Spider (*Oligonychus ulmi* C.L. Koch) ; the Raspberry Mite (*Eriophyes gracilis* Nal.). Reference is also made to slugs destroying hops in the spring.

Massee, A. M. An Eriophyid Mite on Apple. Bull. Ento. Res. 1928 (1929), **19**, 203-204.

SUMMARY.

The Gall Mite *Phyllocoptes schlechtendali* Nal. is recorded as a minor pest of apple. The damage is mainly confined to the leaves, but the fruits are attacked also in some seasons.

The mite is fully described, together with references, host-plants, etc.

Massee, A. M. Two Species of Gall-Mites (*Eriophyidæ*) of The Lilac (*Syringa vulgaris* L.) New to Britain. Bull. Ento. Res., 1928 (1929), **19**, 259-260.

SUMMARY.

Systematic descriptions of the two species of Lilac Gall Mites are given.

Eriophyes löwi Nal. causes the so-called big buds and infests the newly developing buds.

Phyllocoptes massalongoi Nal. causes two types of damage. First, the mites feed upon the leaves causing a yellow-brown mottling of the upper surface. Secondly, the mites attack the unopened flowers, the developing flower buds and the fruits.

THE FRUIT TREE RED SPIDER.

(*Oligonychus ulmi C. L. Koch.*)

By A. M. MASSEE.

The Fruit Tree Red Spider or "Red Spider Mite" (a popular name frequently used by growers) has increased very considerably in fruit plantations during the past few years, and in many districts it has become so abundant that spraying operations have been rendered necessary in order to check its continued spread.

It is sometimes suggested that the Fruit Tree Red Spider is a new pest of fruit trees, but this is not so since this particular species has been known in this country for many years, and reference has been made to it in several entomological works. It is found also on the Continent of Europe and in America, in which country it is known as the European Red Mite.*

Since the mite has occurred only in relatively small numbers in this country for a number of years it is of interest to examine the circumstances contributing to its sudden increase which makes it a pest of economic importance.

Among the chief factors which are considered to account for the increase is the recent introduction and the general and continued use of the dormant winter washes, known as Carbolineum or Tar-Distillate washes. It has been established by experiment that the tar-distillates, applied as dormant winter washes, destroy many kinds of insect eggs, a few of the more important being the eggs of Sucker and Greenfly. It has been ascertained also that these same tar-distillates are not toxic to the eggs of some insects and mites, such as the egg bands of the Lackey Moth and the ova of the Fruit Tree Red Spider, the latter being resistent to the wash even at high concentrations (20 per cent.).

Thus, when a plantation is sprayed with a good brand of tar-distillate, the majority of eggs of various kinds are destroyed, but those of the Fruit Tree Red Spider (and one or two other sorts of insect eggs of little economic importance), remain to hatch normally. In addition to the wholesale destruction of insect eggs, all moss, lichen and such foreign growths on the trees are destroyed, and all the loose bark is removed by the action of the wash. Now, quite a large number and variety of insects normally shelter under the loose bark, in the cracks and in the crevices and as soon as the trees are sprayed these insects are either killed by the spray or must seek fresh shelter for the remainder of the winter. A number of such insects which are known to hibernate upon fruit trees, inlcuding a small Anthocorid Bug (*Anthocoris nemorum* L.), and the Two Spot

* Most American Authors adopt the name of *Paratetranychus pilosus* C. and C. for this species. However, *Oligonychus ulmi* C. L. Koch, claims priority and should be used.

Lady-Bird Beetle, have been observed feeding upon the red spiders during the spring and summer months, and thus one of the effects of winter washing with tar-distillates is to destroy or drive away from the trees a number of insects normally preying upon the red spider, which is thus left to multiply undisturbed.

Finally, since the introduction of tar-distillates, many of the routine sprayings with sulphur and nicotine formerly applied have been discontinued, the significance of which is apparent since both these latter sprays are known to be toxic to adult red spiders.

Recognition of Species.

Although the Fruit Tree Red Spider sometimes occurrs on peach trees and many other plants under glass it must not be mistaken for The Common Red Spider (*Tetranychus telarius* L.) which is only too plentiful upon tomatoes, cucumbers, and numerous other plants of the greenhouse and also abounds upon strawberries, violets and other plants growing in the open, and is even found on fruit trees under certain circumstances.

Apart from the brighter red colour of the greenhouse species the two species of red spider are very similar to each other, but there is one great difference in their life-cycle which enables them to be separated without difficulty. The Fruit Tree Red Spider invariably winters in the egg stage upon the tree, whereas the common greenhouse species (*T. telarius*)* almost always passes the winter in the adult state, and may be found in cracks and crevices of the greenhouse or in other sheltered corners. The common species also spins a web whilst the Fruit Tree species lives freely upon the leaves and no web is produced.

Life-Cycle of Fruit Tree Red Spider.

As already mentioned the Fruit Tree Red Spider spends the winter in the egg stage upon the trees. The eggs are small (considerably smaller than an average size pin head) of globular form, and are red in colour.

When highly magnified the egg appears to be somewhat flattened, the shell is prettily marked by a series of grooves, and a fine hair projects from the top of each egg.

These eggs are laid upon the spurs, around the buds and on the shoots and are also frequently deposited upon the trunks and main branches. Sheltered positions are chosen, chiefly on the undersides of branches. In old and neglected plantations many eggs are laid upon dead wood, amongst moss and even upon the egg masses of other insects such as those of the Vapourer Moth, and upon the egg bands of the Lackey Moth.

* A valuable paper on the Life-cycle of the Greenhouse Red Spider (*T. telarius*) by Edward Speyer, M.A., appears in the Journal of Pomology and Horticultural Science, 1928, **7**, 161-171.

The eggs are laid during the latter part of September and in October and in some seasons during early November also, but this depends upon the state of the weather during the oviposition period which may be shortened to a month or six weeks by continued cold, wet weather.

When the mite population of the tree is scarce, the eggs are difficult to find, and under such circumstances they are best looked for by the aid of a pocket lens. In badly infested plantations the eggs show up very prominently, especially on clear, sunny days, and can be detected quite easily with the naked eye.

Hatching Period of Winter Eggs.

The small reddish immature mites hatch from their eggs in the spring and when first hatched, they are soft, paler in colour compared with the adult mites, and have three pairs of legs. Green, brown and grey individuals are not uncommon, but red is the more usual colour.

The immature stages are very active and commence running along the shoots as soon as they are hatched. If the trees have started to make growth, the young mites begin feeding upon the succulent leaves at once, but food is not necessary during the first few days of their existence. They have been observed to remain alive for seven days without feeding, and eventually to develop normally in spite of this early starvation.

Hatching begins during April, the height of the hatching period being reached about the second week of the month. The weather conditions during the hatching period do not appear to be very important, since the mites have frequently been observed emerging during very cold, wet weather. A small proportion do not hatch until the end of April, and some may even be delayed until the middle of May, but there is no apparent reason for this delayed hatching.

The hatching period has a very important bearing upon the methods suggested for its control and will be referred to again under the heading "control."

Immature and Adult Mites.

The immature mites, whose mouthparts are adapted for biting and sucking, feed upon the opening buds and the developing leaflets. At first they appear to feed upon the upper and lower surfaces of the foliage indiscriminately, but after a few days they are invariably found feeding upon the under surface, usually near the mid-rib of the leaf. In bright, warm weather they run quickly about, and sometimes they may be observed in little groups at the tips of the shoots.

Within a few days of hatching, usually about a week, the first moult occurs after which there is a much closer resemblance to the adult form, which however is reached only after two more moults. Before moulting the mite sticks itself to the underside of a leaf, remains motionless for a while, then runs

off leaving its cast skin behind. There are now four pairs of legs, and in addition the body has numerous hair-like spines upon its upper surface, whilst the colour is usually a darkish red but may vary considerably.

The sexes can be distinguished only by the aid of a binocular microscope and according to the writer's observations the proportion of females to males is about twelve to one.

The mature mites continue to feed upon the foliage and after a lapse of a few days commence to lay, upon the foliage and shoots, their summer eggs which are about the same size as those laid in the autumn, and are brick red in colour. It has not been ascertained how many summer eggs are laid by one individual, but it is thought to be about forty to fifty.

The life of the summer egg is very brief, the immature mites hatching in three or four days, and during warm weather breeding is very rapid, the whole life-cycle being completed within fourteen days.

Successive generations of mites continue to breed throughout the summer and during this period several generations overlap. Thus, adult mites, immature stages, and their eggs may all occur at the same time upon the same tree, and on badly infested trees hundreds of cast skins and empty egg shells may also be observed upon the undersurfaces of the leaves.

The mites do not appear to breed so rapidly during August. In fact it is difficult to find them in numbers, even upon trees known to have been badly attacked earlier in the season. Their eggs, however, may be observed in very considerable numbers upon the leaves and shoots and it is considered that these eggs give rise to the generation of mites that will eventually lay the winter eggs.

Varieties attacked.

The Fruit Tree Red Spider has a very wide range of host plants and occurs upon most varieties of fruit trees.

Apples, plums, damsons and pears are most susceptible, but many other hosts are frequently badly attacked. The mite has been recorded upon the following plants: Medlar, wild service tree, elm, walnut, raspberry, gooseberry, strawberry, tomatoes, cucumbers, quince, red, white and black currants, and once on vines.

Varietal Susceptibility.

While most varieties of apples are attacked to some extent, there is evidence that some sorts are more susceptible than others. Lord Derby, Allington, Worcester, Laxton's Superb and Orleans Reinette are among the susceptible varieties of apples, whilst of the plums, Belle de Louvain, Victoria, and most varieties of damsons are also very susceptible.

Pears are more resistant to attack than apples and plums ; though in some seasons the attack may be pretty general on bush pears.

Nature of Damage.

The damage caused by the mites is mostly confined to the leaves, but on occasions the new growth is dwarfed and stunted. The mites pierce or bite the foliage (generally on the under surface) and then proceed to suck out the sap from the tissues. Very little damage is caused by mild attacks, especially when they occur late in the season. If often happens, however, that the mites breed so quickly during May and June that the trees do not grow fast enough to supply the mites with the necessary food for their existence. At this season the mites become injurious, for as soon as the trees commence to produce new growth, the mites attack the developing foliage and shoots, and after a short while the leaves turn yellow and later a greenish white as the direct result of the attack.

Infested trees, more especially plums, damsons and apples, may be readily detected by the silvery foliage which gives the trees the appearance of having been attacked by the Silver Leaf Disease.

Control Measures.

1. *Distillates and Oils.*

It has been shown that tar-distillates, lime washes, and other insecticides, applied as winter washes will not destroy the winter eggs of the Fruit Tree Red Spider.

More recently, mineral and vegetable oil sprays have been tested, but these have not proved very efficient, although in one experiment, 50 per cent. of the eggs were killed by an oil spray. Even this, however, cannot be described as even fairly good control.

2. *Sulphur Preparations.*

Sluphur sprays may be used with considerable success against the Fruit Tree Red Spider, more especially upon apples, provided they are applied correctly and at the right season.

In view of the prevalence of Apple Scab it is fortunate that sulphur can be recommended, since a combined fungicidal and acaricidal wash can be applied to the trees.

Lime-Sulphur. A pre-blossom lime sulphur spray has proved to be one of the best for controlling red spiders. The lime-sulphur can be obtained in a concentrated form (S.G.1.3) of any insecticide firm of repute and may be diluted as required.

Formula :—

Lime-sulphur	1 gallon.
Water	30 gallons.

(Arsenate of Lead and Nicotine may be added when necessary for destroying caterpillar and aphis).

Time of application. As already mentioned the success of the spraying depends largely upon the time of application.

It is known that sulphur preparations do not destroy the eggs of the Fruit Tree Red Spider and thus it is imperative to delay spraying until the mites have hatched from their eggs. Unfortunately it is not possible to wait until all the mites have hatched, since some of them do not emerge before May, when it is not safe to use lime-sulphur at a concentration of 1 in 30.

Apples. Apples should be sprayed with lime-sulphur (1 in 30) about one week before the blossoms open. If possible a sunny day should be chosen because it has been observed that lime-sulphur is more toxic to the mites when applied on fine days. If, by force of circumstances, spraying is carried out in dull or wet weather, the result will not be so good. A coarse nozzle should be used and it is essential to wet all the foliage, shoots, etc., with the spray. Normally, one application, if thoroughly carried out, is sufficient but in very badly infested orchards a post blossom spray may be applied as well. As some varieties of apples are very susceptible to sulphur spray injury, the post blossom application must be used at the reduced strength of 1 in 80 or even 1 in 100.*

Plums. Plums may be sprayed with lime-sulphur but the results are not so good as with apples because it is necessary to spray the former much earlier in the season. Plums are very susceptible to spray injury, and when a concentration of 1 in 30 is used, care must be taken to ensure that spraying is complete before the flowers open, otherwise severe scorching will result.

Liver of Sulphur Wash. Liver of Sulphur (Potassium sulphide) has proved to be an excellent pre-blossom spray for controlling red spider and under certain conditions it is better than lime-sulphur.

Formula :

Liver of Sulphur	50 ozs.
Soft Soap	5 lbs.
Water	100 gallons.

Procure fresh, lump liver of sulphur and dissolve it in hot water. Add this to the soap and the required quantity of water just before using.

This spray is applied exactly the same time as lime-sulphur, namely, one

* No sulphur spray at all should be applied to such a variety as Stirling Castle, which is very susceptible to damage by sulphur.

week before the flowers open in the case of apples, and a few days before the blossoms for plums.

The effect of liver of sulphur is very marked, and even in rainy or unsettled weather sufficient spray remains on the foliage to destroy the mites. It is also considered that liver of sulphur destroys mites which hatch several days after the wash has been applied, but this has not been confirmed by experiment.

Summary.

An account is given of the life-history and the distribution of the Fruit Tree Red Spider.

The host plants are recorded together with remarks upon susceptible varieties of fruit.

The damage caused by the mite is also described, and control measures are outlined in the report.

THE BLACK CURRANT GALL MITE ON RED CURRANTS.

By A. M. MASSEE.

During the past two seasons numerous reports have been received at East Malling to the effect that some varieties of red currants, principally Raby Castle and Fay's Prolific have failed to crop, and that the buds on the two and three year old wood have not developed in the usual manner.

A detailed examination of the buds showed that in many instances they were infested by the Black Currant Gall Mite. This Mite could be found in large numbers and was doubtless responsible for the failure of the bushes.

Symptoms of the Disease.

The Black Currant Gall Mite does not attack red currants in the same manner as it does black currants. For example, the familar " Big Buds " only too common on black currants are not to be seen on reds. However, in instances of severe infestation the buds tend to swell out somewhat, especially those situated around the collar of the bushes. These slightly swollen and malformed buds may be seen from November to May. In the variety Fay's Prolific a dense growth of buds is produced ; these buds do not develop normally and eventually dry out.

When the attacked buds are examined with the aid of a binocular microscope, several thousands of mites in all stages will be seen inside the buds. Eggs are found also in the diseased buds.

Detection of Presence of Mite in the Plantation.

It is rather difficult to find the mites during the autumn and early winter, since the buds are in a dormant condition and the symptoms of the disease are not apparent. The diseased buds may be seen readily in the spring as soon as the buds begin to open. At this period, the buds infested by mites remain in a dormant state and thus stand out conspicuously. These dormant buds have frequently been referred to as " Blind Buds." The general opinion appears to be that these so-called " blind buds " are caused as the result of bird attacks during the winter months. The writer is aware that these " blind buds " are sometimes attacked by birds, but it is considered that the birds (mainly Tits) are seeking the mites inside the buds, and are not primarily after the buds themselves.

Notes on the Habits of the Mites.

The Mites live on the underside of the leaves during the spring and summer months. Eggs are deposited on the foliage. In the autumn the mites seek shelter within the buds. They continue to feed and breed inside the buds, where they remain until the following spring. Round about the first and second week in April, according to the season, the Mites come out of the buds and go once again to the leaves. The infested buds eventually dry out.

Varieties chiefly attacked.

Raby Castle is attacked more than any other variety. Fay's Prolific also suffers to a marked degree, while many other sorts are affected to a lesser extent. Among these may be noted, New Red Dutch, Old Red Dutch, and La. Constante.

Control Measures.

Preliminary spraying investigations have been undertaken during the past year, and there are indications which suggest that it will be possible to eradicate the mite by spraying with lime-sulphur in the spring, as soon as the buds commence to open. At this period the mites begin to leave the attacked buds, and are killed by the spray.

Part VI

Hops

Part VI

HOPS.

Work has been further continued on the lines of the extended programme of investigation adopted in January, 1926. *Clone races of principal commercial varieties* have been established from a hill, the botanical characters of which are being described. These are now being worked up in sufficient quantities for planting up trial plots.

New Seedlings.

The twelve most outstanding of Professor Salmon's new seedling varieties tested at Malling during the first fourteen years, have now been planted out in four random blocks of fifteen hills of each variety. The commercial varieties, Bramling, Tutsham and Canterbury Golding, have been planted as controls for the early, mid-season and late varieties respectively.

The aim of these trials is to provide more reliable cropping records and at the same time to grow a bigger bulk of the varieties for brewing trials.

Hops in 1927 were poor in preservative substances, the reduction being about 2 or $2\frac{1}{2}$ per cent. Certain new varieties again proved richer in preservative qualities than any of the commercial varieties tested, when analysed by the Ford and Tait method. In 1924 and 1926 certain new varieties at Malling proved richer in preservative substances than the richest American hops obtainable, whilst in 1927 American hops far exceeded the English varieties.

Further batches of new seedlings are undergoing their preliminary trials.

Incidence and Control of Downy Mildew.

There was an exceptionally severe attack of the " spike " form of the disease in the spring and summer, both " basal " and " terminal " spikes being found in large numbers from April 12th until July 10th. All spikes were removed from the hills as soon as noticed. The subsequent dry weather probably checked the spread of the disease to the cones, and thus although several rows of Tutsham and of many seedling varieties were sprayed with Bordeaux Mixture as a control of the disease, it was impossible to judge its effects, both control and sprayed plants remaining free from attack.

PUBLICATION DURING THE YEAR.

*Salmon, E. S. S. E. Agricultural College, Wye. Eleventh Report on the Trial of New Varieties of Hops, 1927. August 1928.

*Report on data collected jointly, upon Hops grown at East Malling.

Part VII

Meteorological Observations

Part VII

WEATHER CONDITIONS DURING 1928.

By H. C. CHAPELOW and H. M. TYDEMAN.

The chief feature of interest in the weather during the past year has been the extremely satisfactory quantity of sunshine experienced. Actually the year's aggregate of 1,760 hours has not been exceeded at this Station in any year since sunshine records have been taken. Of the twelve months, only one, May, has a quantity of sunshine less than the normal, although in several cases, notably those of March, April and November, the average was only exceeded by a fractional quantity.

With regard to rainfall, notable departures from the average occurred in January and October, both of which had a rainfall appreciably in excess of the normal, and in September, when the total rainfall of 0.34 inches was very considerably below the average. On the whole, the total rainfall of 28.36 inches was a quite average quantity although its distribution deviated perceptibly from the usual sequence.

From the horticultural viewpoint the weather during 1928 showed a distinct advance upon that of its predecessor. During the nine months of the year (January-September) vital to the prosecution of cultural and harvesting operations, rainfall was adequate but not excessive, with plentiful sunshine, reaching a maximum in July with over three hundred hours, or almost ten hours per day, and decreasing only by gradual stages thereafter. The mean temperature of the air during this period corresponded very closely with the average of the last thirteen years. While ground frosts were considerably more abundant than during the corresponding period of 1927 and were apparently of equal severity, they were by no means so destructive to the blossoms of the fruit trees.

Diagram showing Average Sunshine for 14 years in 10-day periods.

SUMMARY OF METEOROLOGICAL OBSERVATIONS DURING 1928.

	Barometer.	Temperature in Screen.				On Grass.			No. of Frosts.	Rainfall.				Sunshine.			Hygrometer.			Wind.
	Mean Reading.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Mean.	Mean.	Lowest.		Total (ins.)	No. of days.	Av. per rainy day.	Heaviest fall in any one day.	Total hours.	No. of days.	Av. per sunny day.	Mean of dry bulb.	Av. deprec. of wet bulb.	Av. humidity.	Direction.
January ..	29.858	46.8	34.0	56	22	40.4	27.2	11.0	21	3.48	20	0.17	0.72	56.9	17	3.4	39.9	1.2	89	W.
February ..	30.042	49.9	34.6	57	26	42.2	28.6	18.0	18	1.23	13	0.09	0.29	103.3	25	4.1	41.1	1.9	83	W.
March ..	29.771	50.1	36.7	64	20	43.4	30.2	15.0	12	1.71	15	0.11	0.67	110.8	23	4.8	43.7	2.2	82	S.S.W.
April ..	29.736	54.6	38.6	72	29	46.6	32.0	22.0	13	2.01	16	0.12	0.61	131.2	22	5.9	48.7	3.8	73	N.E. & N.W.
May ..	29.936	60.1	42.6	75	31	51.3	37.0	20.0	9	2.00	13	0.15	0.85	181.2	29	6.3	53.1	4.2	72	N.E.
June ..	29.904	65.2	46.9	74	36	56.0	41.5	28.0	2	2.40	15	0.16	0.37	232.3	30	7.7	58.8	5.8	66	W.S.W.
July ..	30.049	74.9	53.0	88	43	63.9	46.9	38.0	0	1.58	7	0.22	0.63	304.5	31	9.8	66.3	4.9	75	W.S.W.
August ..	29.912	69.7	51.9	79	41	60.8	45.0	36.0	0	2.25	16	0.14	0.66	210.4	31	6.8	62.9	4.4	75	S.W.
September ..	30.066	66.9	43.9	81	32	55.4	36.8	30.0	3	0.34	4	0.08	0.24	219.4	29	7.6	58.4	3.8	77	S.W. & N.W.
October ..	29.981	59.2	43.9	67	28	51.5	37.3	21.0	7	4.50	20	0.22	0.85	102.0	27	3.8	52.3	2.4	83	S.S.W.
November ..	29.739	52.7	42.0	59	25	47.3	35.9	19.0	7	3.19	20	0.16	0.57	57.9	19	3.0	46.3	1.6	87	S.S.W.
December .	29.944	44.3	34.3	53	20	39.3	27.9	11.0	17	3.67	19	0.19	0.87	50.5	15	3.4	37.9	1.0	91	N.W. & S.S.W.

SUMMARIES OF MEAN TEMPERATURE, RAINFALL AND SUNSHINE FROM AUGUST 1914 TO DECEMBER 1928.

Compiled by H. M. TYDEMAN and H. C. CHAPELOW,
from records obtained by J. Amos (1914-1921), H. M. Tydeman (1921-1928) and
H. C. Chapelow (1925-1928).

Meteorological observations have now been kept at this Station since August, 1914. While these accumulated records do not cover a sufficient length of time to make the averages a safe indication of the general trend of weather in this locality, they provide, at least, an interesting history of the conditions here during the period covered.

With reference to Table 1., Summaries of Mean Temperature, a number of interesting comparisons may be made. While 1921 as a whole, was considerably the warmest year of the fourteen, with an average of 52.3 degrees, November of that year was several degrees below the average and was among the three coldest Novembers experienced during the period. Again, while 1917 is distinguished by the fact that it has the lowest average temperature, yet the mean for May and June of that year were the highest ever recorded for those months, both being four degrees above the average.

If the seven year period, 1915 to 1921, be compared with that from 1922 to 1928, it will be noticed that the range of mean temperature was much more restricted during the latter of these two periods. For example, during the months of January of the period 1915 to 1921, the highest mean temperature experienced was 46° in 1921, the lowest was 36.2° in 1917, a range of ten degrees. During the period 1922 to 1928, the highest January mean temperature recorded was 42.8° in 1922, and the lowest was 39.4° in 1926, a range of only 3.4°. Similar, though slightly less striking instances of the same thing are to be found in the case of March, April, June, August, October and December.

Finally a few comparisons of the values for this Station with those of other centres may be of interest. A note of warning should, however, be sounded at the outset. The values used for these comparisons were abstracted from the Monthly Reports of the Meteorological Office and are the thirty-five year averages for the period 1881 to 1915; correlations between the two sets of data must therefore be made with extreme caution. A study of the figures for this Station indicates that there is a tendency for the mean temperatures to be higher during the latter than the former end of the period. This is particularly noteworthy in the case of the months April, July and November. If this indicates a general

upward trend in mean temperature, it is even more necessary to use extreme care in drawing deductions from comparisons with the figures for centres whose averages cover a longer and earlier period.

Taking first the figures for Clifton, Glos., it is found that for the first three months of the year the mean temperature at Clifton is slightly below that of Malling, and that for the next four months, April to July inclusive, Clifton is warmer than Malling by an amount varying from 0.2° to 2°. Thereafter, Clifton is uniformly colder than here, the disparity becoming gradually greater as the year advances, until in December the difference between the respective averages is one of 2.3°. At Hereford, in the West Midland fruit area, taking the figures as a whole, it may be said that with few exceptions temperatures range somewhat lower than at Malling. In only two months, April and June, when the average is less than one degree higher at Hereford than at Malling, is this not the case; in the remaining ten months the average here is higher than that at Hereford by an amount which varies from 0.6° in July to 5.3° in September. At Wisley, in Surrey, the averages approximate very closely to those of the Hereford centre and are also somewhat lower during the greater part of the year than at Malling, April and June being the only exceptions, as in the case of Hereford.

Table 2 shows the Monthly Rainfall in inches at this Station. 1927 was easily the wettest of the fourteen years, and it is rather curious to note that five of the twelve months had a rainfall below the average, that of May being particularly meagre. The total was, however, considerably swelled by the large amounts recorded for the months from June to September inclusive. On the other hand, the year 1921 stands out as the driest of the fourteen, with a total of less than thirteen inches. If the totals for the years alone are considered, a steady decline in the rainfall from 1915 to 1921 is observed, 1919 being the only exception. A similar series though in the reverse direction may be noted from 1921 to 1927, the movement in this case being somewhat masked by the totals of 1923 and 1924, which do not conform to the sequence.

When the rainfall at Malling is compared with that for the three other centres with which comparisons of mean temperature were made, some interesting differences are to be found. The reservation made in the case of the mean temperature comparisons must be again emphasised. At Clifton the average annual rainfall for the period 1881 to 1915 was 33.8 inches, compared with 26.2 inches at this Station for the period 1915 to 1928. In no month was the average at Clifton less than that at Malling and the differences are most striking for the months of March, June, August and October, in the two latter months the averages differed by an inch and a quarter and an inch and a half respectively. At Hereford the average annual rainfall for the earlier period approximates much more closely to that of this centre for the more recent period. Its distribution through the months follows a somewhat different course, however, May, June

and October having a distinctly higher average rainfall at Hereford than at Malling, while the reverse is true of April, November and December. The annual rainfall at Wisley is approximately one and a half inches less than that at Malling. Really significant discrepancies, however, occur only in January, October and December.

The Monthly Totals of Sunshine at this Station are set out in Table 3. It is interesting to note that 1928 was the most sunny year of the fourteen, and that only one month, May, was below the average. May was the sunniest month of the twelve in six of the fourteen years, July in four instances, June in three cases and August once.

TABLE 1.

MEAN TEMPERATURE OF AIR IN SCREEN.—AUGUST 1914 TO DECEMBER, 1928.

	1914.	1915.	1916.	1917.	1918.	1919.	1920	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	Average.
JANUARY ..	—	38.8	45.6	36.2	39.0	38.6	42.4	46.0	42.8	41.6	41.4	41.4	39.4	40.1	40.4	41.0
FEBRUARY	—	39.9	39.7	34.1	44.3	36.4	43.2	40.9	42.6	42.6	37.2	39.9	46.2	39.5	42.2	40.6
MARCH ..	—	42.9	39.6	40.0	45.5	49.8	46.2	45.9	42.2	44.4	39.8	40.6	44.3	45.5	43.4	43.6
APRIL ..	—	45.4	47.7	41.3	46.6	44.3	48.8	48.2	43.6	46.9	45.9	46.2	48.5	47.7	46.6	46.2
MAY ..	—	52.7	53.1	57.0	56.1	55.7	54.8	54.8	56.3	50.6	55.0	54.6	51.0	52.4	51.3	53.9
JUNE ..	—	56.9	53.4	62.4	56.2	58.8	58.1	59.9	60.5	54.7	58.2	58.8	56.3	55.9	56.0	57.6
JULY ..	—	59.5	59.7	61.0	60.3	58.0	59.7	66.1	58.8	65.6	58.7	67.7	62.9	60.3	63.9	61.6
AUGUST ..	62.3	61.0	62.4	59.8	62.0	63.4	57.2	62.4	58.3	61.2	57.7	60.5	61.7	61.0	60.8	65.1
SEPTEMBER..	58.6	58.0	57.2	58.9	56.1	57.3	56.5	59.1	55.7	55.9	55.7	53.4	59.7	55.3	55.4	60.9
OCTOBER ..	51.1	49.6	52.3	47.7	46.6	46.6	51.1	56.9	47.8	51.1	50.7	51.4	46.8	50.4	51.5	53.7
NOVEMBER ..	44.7	40.1	44.0	47.0	42.9	39.1	43.4	42.0	41.9	38.4	43.8	40.4	49.7	42.5	47.3	46.2
DECEMBER ..	41.8	44.6	38.0	38.5	48.3	42.4	40.9	45.0	42.1	39.2	42.7	37.6	39.8	35.6	34.7	43.6

TABLE 2.

MONTHLY RAINFALL IN INCHES.—AUGUST, 1914 TO DECEMBER, 1928.

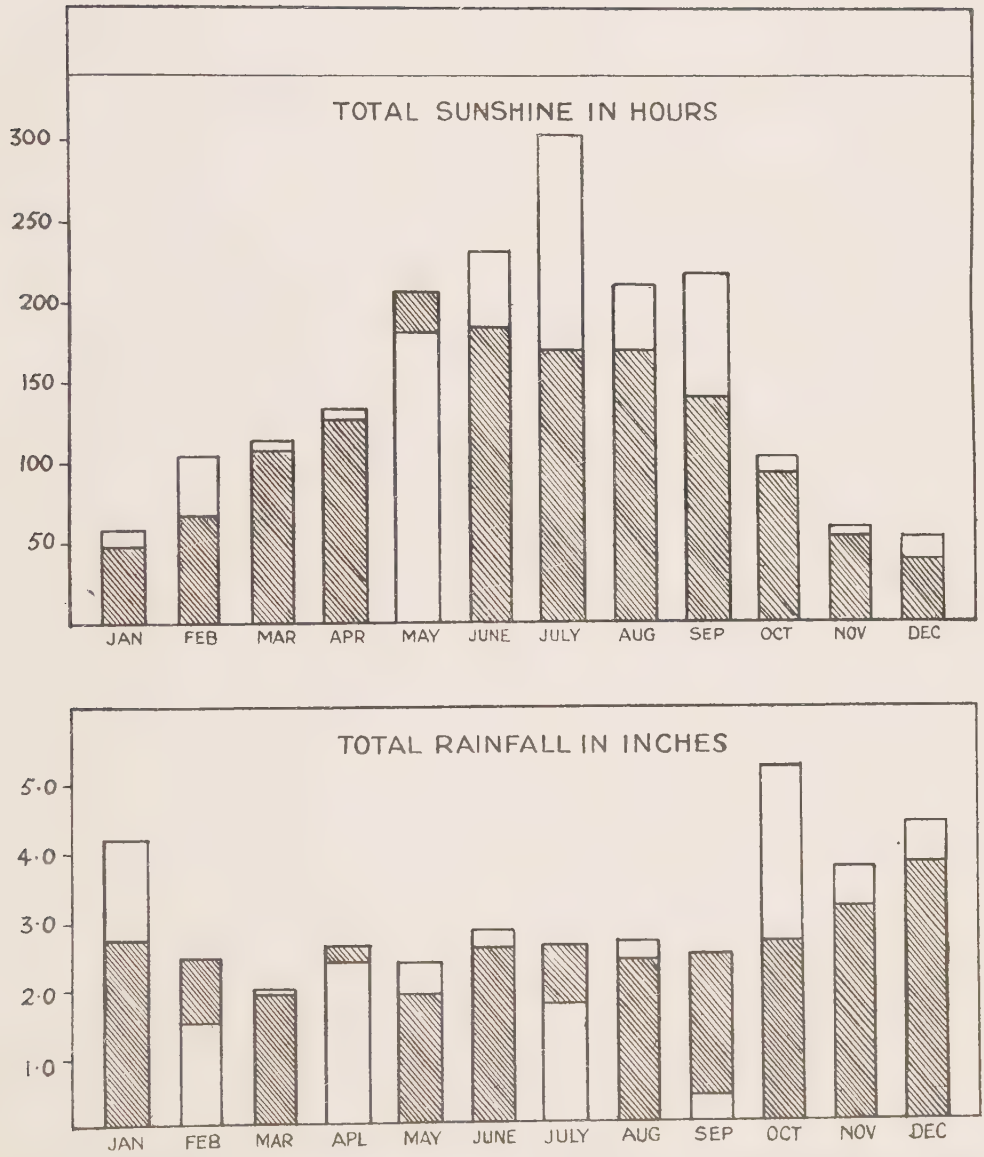
	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	Average.
JANUARY ..	—	3.090	1.430	0.995	1.680	4.755	2.860	2.140	2.380	1.035	2.390	1.990	2.460	2.250	3.480	2.352
FEBRUARY	—	3.415	3.860	0.730	0.630	1.710	0.410	0.835	1.645	3.795	0.600	3.270	2.480	3.980	1.235	2.042
MARCH ..	—	0.930	3.735	1.485	0.785	3.720	0.835	1.190	1.600	1.905	1.140	0.880	0.380	3.110	1.710	1.671
APRIL ..	—	1.215	1.625	2.025	2.055	1.810	2.830	1.275	2.180	1.935	3.310	2.010	4.770	1.580	2.010	2.188
MAY ..	—	2.965	1.835	2.170	1.165	0.620	0.610	1.080	0.780	2.765	2.200	2.010	1.860	0.840	2.005	1.636
JUNE ..	—	1.275	2.070	0.830	1.725	1.025	0.720	0.125	1.400	0.790	2.030	0.280	2.640	3.730	2.405	1.503
JULY ..	—	3.705	1.125	3.665	3.875	3.065	2.405	0.355	2.500	0.785	2.990	0.345	1.710	3.960	1.580	2.290
AUGUST ..	0.580	1.890	1.860	4.865	1.055	2.585	1.565	0.910	2.125	1.455	1.905	1.790	1.320	4.570	2.255	2.048
SEPTEMBER..	0.800	3.000	0.305	1.175	2.845	1.125	3.150	1.070	2.760	1.760	3.750	1.800	0.670	4.760	0.340	1.956
OCTOBER ..	2.115	1.660	2.565	3.640	2.090	0.855	0.920	0.830	1.375	5.685	3.930	3.550	2.460	1.425	4.505	2.507
NOVEMBER ..	2.750	3.140	4.335	1.675	1.660	3.005	1.090	1.505	1.405	2.320	3.200	2.850	5.810	2.455	3.190	2.692
DECEMBER ..	6.725	6.030	3.455	2.185	1.875	3.710	2.325	1.665	3.210	2.340	3.470	3.010	0.740	4.680	3.665	3.272
TOTAL ..	—	32.315	28.200	25.440	21.440	27.985	19.720	12.980	23.360	26.570	30.915	23.785	27.300	37.340	28.380	26.123

TABLE 3.

MONTHLY AGGREGATES OF SUNSHINE.—AUGUST, 1914 TO DECEMBER, 1928.

	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	Average.
JANUARY ..	—	37.8	46.7	43.3	70.2	35.7	56.6	42.2	37.2	46.3	43.1	47.3	52.5	57.5	56.9	48.1
FEBRUARY	—	70.9	71.6	63.8	68.8	60.8	87.7	76.7	105.9	49.6	33.2	77.7	46.5	46.9	103.3	69.0
MARCH ..	—	87.1	49.9	91.7	159.7	74.3	131.0	139.0	74.6	79.7	166.3	94.5	126.8	121.5	110.8	107.5
APRIL ..	—	133.7	176.9	134.8	65.3	87.0	83.8	186.0	126.2	101.2	110.3	146.5	110.4	157.5	131.2	125.0
MAY ..	—	213.7	191.8	216.3	207.0	245.0	208.5	184.5	257.0	127.9	181.5	238.8	156.0	254.2	181.2	204.5
JUNE ..	—	183.7	149.2	218.7	230.0	189.4	176.0	191.3	193.0	83.3	166.3	256.9	169.7	168.4	232.3	186.3
JULY ..	—	155.9	173.2	187.3	186.2	107.8	122.9	231.6	132.3	219.3	183.3	191.8	177.2	140.7	304.5	179.5
AUGUST ..	171.9	126.9	172.3	138.2	205.8	209.3	138.3	155.8	123.0	216.9	156.3	163.6	209.9	173.9	210.4	171.4
SEPTEMBER ..	189.4	188.2	102.7	162.0	168.2	164.8	101.0	168.6	105.9	171.2	93.3	132.7	135.9	112.8	219.4	147.7
OCTOBER ..	69.9	74.9	90.1	101.8	69.8	126.4	149.0	154.1	88.9	71.9	77.1	109.3	96.5	96.6	102.0	98.5
NOVEMBER ..	60.3	63.5	62.1	42.9	68.8	47.0	81.0	61.2	31.2	71.8	36.2	74.9	38.3	49.6	57.9	56.4
DECEMBER ..	32.6	33.1	17.3	40.6	35.2	25.1	28.3	31.4	49.8	17.9	47.0	56.5	62.2	40.9	50.5	37.9
TOTAL ..	—	1369.4	1303.8	1441.4	1535.0	1372.6	1364.1	1622.4	1325.0	1257.0	1293.9	1590.5	1381.9	1420.5	1760.4	1431.3

Diagram showing Average Rainfall for 14 years in 10-day periods.



Diagrams howing Total Sunshine and Rainfall during 1928 compared with previous 14 years average. Shaded portion 14 years average.

RULES OF ASSOCIATE MEMBERSHIP OF THE KENT INCORPORATED SOCIETY FOR PROMOTING EXPERIMENTS IN HORTICULTURE.

EAST MALLING RESEARCH STATION, KENT.

There are three Groups of Associate Members :—

Group A.—(Associate Members) "Founders."

Membership of this group is obtained by :—

A Single donation of £25 for Life Founders.

An annual subscription of £10 10s. for Annual Founder Members.

Founder Members are entitled :—

i. To receive the Annual Report of the Society, together with the supplement of special articles, free.

ii. To receive all other reprints and bulletins free.

iii. (*a*) To share (proportionately) in any distributions of selected material, at prices fixed by the Committee, and to be notified of such distributions and prices.

(*b*) To have priority in the matter of sharing in any distributions of novelties (if any) raised by the Station.

iv. To have advisory letters answered without a fee being charged.

v. (*a*) To receive special consideration in the matter of advisory visits, the identification of bushes, stocks, canes, etc.

(*b*) To obtain a reduction of fee where special services (such as the "roguing" of stock beds, etc.), involve extended journeys and visits.

vi. To be notified of and eligible to attend all meetings of Associate Members, of which there shall be at least one annually for Founder and Fellow Associate Members.

vii. To be notified of and eligible to attend all General Meetings of the Society.

Group B.—(Associate Members) "Fellows."

Membership of this Group is obtained by :—

A single donation of £15 15s. for Life Fellows.

An annual subscription of £3 3s. for Annual Fellows.

Fellows are entitled to :—

i. Similar to Group A.

ii. To receive on application all other reprints and bulletins at cost price.

iii. (*a*) Similar to Group A.

iv. Similar to Group A.

v. (*a*) Similar to Group A.

vi. Similar to Group A.

vii. Similar to Group A.

Group C.—(Associate Members) "Associates."

Membership of this Group is obtained by :—

A single donation of £10 for Life Associates.

An annual subscription of £1 1s. for Annual Associates.

Associates are entitled :—

i. To receive the Annual Report free.

ii. To receive on application the Supplement of special articles, and any other reprints and bulletins at cost price.

iii. (*a*) Similar to Group B.

iv. Similar to Groups A. and B.

vi. To be notified of and eligible to attend all Associates days, of which it is hoped to have at least one annually.

vii. Similar to Groups A. and B.

Societies, Associations, Clubs, etc., donating or subscribing similar sums corporately will be admitted to Associate Membership on similar terms. They will be eligible for proportionate privileges for their Members and to send representatives to the General Meetings. Such Associations will also have a prior claim upon the services of any Member of Staff prepared to give Lectures.

All Annual Subscriptions will be payable before the end of March in each year. If the subscription is three months over due no further reports or notifications will be sent and membership will lapse.

Life Membership donations may be sent at any time.

In filling up the application form for Membership (at the end of the Report) each prospective member is invited to state the privileges he wishes to exercise.

FORM FOR ASSOCIATE MEMBERSHIP

OF

THE KENT INCORPORATED SOCIETY FOR PROMOTING EXPERIMENTS IN HORTICULTURE.

EAST MALLING RESEARCH STATION, KENT.

I desire to be a { Life* / Annual } { Associate Member—"Founder*" / Associate Member—"Fellow" / Associate Member—"Associate" } of the society, and I enclose herewith { donation* / subscription } required by the rules.

I wish to exercise the following privileges attaching to such Membership (here refer to each privilege by the number given in the attached rules), i.e., Nos.

Name .....

Address .....

.....

Date .....

To THE SECRETARY,
THE RESEARCH STATION,
EAST MALLING, Kent.

* Please cross out the inapplicable words.

LIST OF SUBSCRIBER "ASSOCIATE MEMBERS" DURING THE YEAR.

1st January, 1928, to 31st December, 1928.

Group A.—"Founders."

* Denotes *Annual* member as distinct from *Life* member.
† Denotes *Life* member and *Annual* subscriber.

†Cadbury, Messrs. ..	Bournville Village Trust, Estate Office, Bournville, Birmingham, Warwick.
Chaytor, A. D. ..	Iridge Place, Hurst Green, Etchingham, Sussex.
†Chivers & Sons, Messrs. ..	Estate Office, Histon, Cambridge.
†Faversham Branch N.F.U.	33, Roman Road, Faversham, Kent.
†Hardy, Rt. Hon. Laurence	Sandling Park, Hythe, Kent.
*Jones, L. ..	Plantation Stock, near Ingatestone, Essex.
May, G. ..	Hermitage Farm, Barming, Kent.
*Norfolk County Council	The Shire House, Norwich, Norfolk.
Prall, J. A. & Sons, Ltd. ..	Matfield Nurseries, Paddock Wood, Kent.
Smeed, Dean & Co., Ltd. ..	Murston, Sittingbourne, Kent.
†United Potash Coy., Ltd.	Fenton House, 112, Fenchurch Street, London, E.C.3.
†Wolmer, Lord ..	Blackmoor, Liss, Hampshire.

Group B.—"Fellows."

*Barton, J. L. ..	Broadwater, East Malling, Kent.
*Bennett, H. E. ..	Ditton Court, Larkfield, Kent.
*Bromley, N. B. Warner ..	Finsbury House, Blomfield Street, London, E.C.2.
*Columbo Commercial Co. Ltd. ..	Thames House, Queen Street Place, London, E.C.4.
*Filmer, A. Wilson ..	Leeds Castle, Maidstone, Kent.
*Greenfield, A. ..	Ryarsh, West Malling, Kent.
*Henderson, Commander F. B. ..	Little Blakenham, Ipswich, Suffolk.
†Hillier & Sons, Messrs. ..	West Hill Nurseries, Winchester, Hampshire.
*Holdsworth, R. K. ..	Belchambers Farm, Kirdford, near Billingshurst, Sussex.
†Kitchin, J. ..	Boughton Place, Sandway, near Maidstone, Kent.
Linfield, A. G. ..	Worthing, Sussex.
*Mann, W. E. ..	Carmuirs, Soham, Cambs.
Morford, L. ..	Parsonage Farm, Bronchley, Paddock Wood, Kent.
*Murphy & Sons, Messrs.	Sheen Lane, Mortlake, London, S.W.14.
†Norton, Captain R. A. ..	Downs House, Yalding.
*Richards, W. ..	Poulters, Bentley, Hampshire.
*Robbins, A. J. & Sons, Ltd.	Vicarage Farm, Hounslow, Middlesex.
Sandford, T. C. G. ..	Preshute House, Marlborough, Wilts.
*Tickler, T. G., Ltd. ..	The Fruit Farms, Bradley, near Grimsby, Lincs.
†Warde, Col. Sir Charles Edward ..	Barham Court, Maidstone, Kent.
*West, S. ..	Ewhurst Place, Ewhurst, Hawkhurst, Kent.

Group C.—"Associates."

*Acherson, C. S.	Stede Court, Harrietsham, Kent.
*Alexander, W.	Home Farm, Eynsford, Kent.
*Allen, Major G.	Payne Street, Charing, Kent.
*Ash and District:N.F.U.	35, Moat Sole, Sandwich, Kent.
*Aspland, A. Lees	"Kalgan," Welwyn, Herts.
*Attrell, E. S.	Warren Fruit Farm, North Common, Chailey, Sussex.
*Baiss, R. S. H.	Church House, Beckley, Sussex.
*Batt, Lt.-Col. R. B.	Gresham Hall, Norwich, Norfolk.
*Bear, E. M.	Magham Down, Hailsham, Sussex.
Beeton, H. R.	Hammonds, Checkenden, Reading, Berks.
*Berry, H. A.	Iverley, near Stourbridge, Worcestershire.
*Bevington, Miss Marion	Wybournes, Kemsing, near Sevenoaks, Kent.
*Bligh, E. R.	Goddard's Green Farm, Benenden, Kent.
*Boddington, F.	The Manor Fruit Farm, Burghill, Hereford.
*Bowring, A.	The Oaks, Goudhurst, Kent.
*Burrell, R. J.	Risby Place, Bury-St-Edmunds, Suffolk.
*Casson, H. A.	Tyn-Y-Coed, Arthog, North Wales.
*Chabot, W. G.	Gooiland Nurseries (G. Wesseling & Co.), Naarden, Holland.
*Chambers, Rev. F.	Lested Lodge, Chart Sutton, Maidstone, Kent.
*Chapman, Mrs. E. G.	150, Huntingdon Road, Cambridge.
*Clarke, B.	Little Blakenham, Bramford, Suffolk.
*Clarke, Mrs. L. Pearce	The Grey House, Sevenoaks, Kent.
*Cornwell, B.	118, Park Road, Sittingbourne, Kent.
*Danreuther, W.	Battle Fruit Farm, Battle, Sussex.
*Davison, G. D.	Westwick Gardens Fruit Farm, Westwick, Norwich, Norfolk
*Dixon, T. & M., Messrs.	Tardebigge, Bromsgrove, Worcester.
*Dow, A.	Headcorn, Kent.
*Elgar, N. E. B.	Stallance, Su tton Valence, Maidstone, Kent.
*Fillmer, Miss S.	Horticultural College, Swanley, Kent.
*Firkins, A. R.	The Moor, Eardiston, Tenbury, Worcester.
*Fleming, O.	Toys Hill, Sevenoaks, Kent.
*Gamble, O.	Dunedin, Mark Cross, Tunbridge Wells, Kent.
*Gillian & Son, Messrs.	Tongham, Fruit Farm, Tongham, Surrey.
*Goodhew, L. J.	8, East Street, Sittingbourne, Kent.
*Goodson, S. G.	Frognall, Wickhambreaux, Canterbury, Kent.
*Granger, H.	Maldon Fruit and Poultry Farm, Fambridge Road, Maldon, Essex.
*Grey, Countess Mabel	Howick, Alnwick, Northumberland.
*Groom, H. C. & Co.	Bellevue Farm, Guilden Sutton, Chester, Cheshire.
*Gwynn, Rev. R. L.	Little Easton Rectory, Dunmow, Essex.
*Gwynne, H. A.	Mawbyns, Dunmow, Essex.

Hall, J. & E., Ltd. ..	Dartford Ironworks, Kent.
*Harraway & Sons, Messrs.	The Nurseries, Warminster, Wiltshire.
†Harthan, Dr. G. E. ..	Badgers Hill, Sheriffs Lench, Evesham, Worcestershire.
*Have, Van der ..	Kapelle, near Goes, Holland.
*Hitchins, P. E. N. ..	Stream View Nurseries, Horeham Road, Sussex.
*Hollands, W. T. ..	Court Lodge, West Malling, Kent.
*Hübsch, O. Schmitz ..	Merten, Kreis Bonn, Germany.
*Hübsch, E. Schmitz ..	Merten, Kreis Bonn, Germany.
*Huxley, H. ..	Wootton Close, Boar's Hill, near Oxford.
*Jackson, W. T. ..	117, High Street, Sittingbourne, Kent.
James, A. ..	Fritham, near Lyndhurst, New Forest, Hampshire.
*Jenkins, Major C. E. ..	Brooksbank, Copythorne, Southampton, Hants.
*Jongh, Wed P. de., Ltd. ..	Nurserymen, Goes, Holland.
Kakebeeke, F. ..	Goes, Holland.
*Kallen, H. Van der ..	Boskoop, Holland.
*Kenyon, G. ..	Oast House, Stourmouth, near Canterbury, Kent.
*Lacey, G. W. ..	Warmley, Bristol.
*Langrish & Chalcraft, Messrs.	Wheatley, near Bordon, Hampshire.
Leigh, J. G. ..	5, High Street, Daventry, Northampton.
*Lewis, N. S. ..	Mumford, Wittersham, Kent.
*Lockett-Wood, Dr. T. ..	The Holme Estate, Bratton, Westbury, Wilts.
*Luck, Colonel B. J. M. ..	The Hermitage, West Malling, Kent.
Lupton, G. H. ..	Elgin, C. P. South Africa.
*MacFarlan, Lt.-Col. J. B.	Invermay, Knowle, Budleigh Salterton, Devon.
*Machin, N. F. ..	Redhill Farm, Wateringbury, Kent.
*Matheisens Planteskole ..	Kørsør, Denmark.
*McClintock, Major H. F.	The Red House, Ardee, Co. Louth, Ireland.
*Murton, E. ..	Langton, Hawksdown, Walmer, Kent.
Nix, C. G. A. ..	Tilgate, Crawley, Sussex.
*Noble, Major W. J. W. ..	5, Cumberland Road, Bromley, Kent.
*Norfolk, East, Fruit Growers' Association ..	Wroxham, Norfolk.
*Overseas' Farmers' Co-operative Fed., Ltd. ..	88-89, Chiswell Street, London, W.C.
*Padwick, H. ..	The Manor House, West Ashling, Chichester, Sussex.
*Page, C. J. ..	Old Rectory Fruit Farm, Goldhanger, Maldon, Essex.
*Pardoe, F. S. ..	Hazeldene, Horeham Road, Sussex.
*Parsons, E. ..	49, Queen Anne Street, Cavendish Square, London, W.
*Peet, H. F. ..	Glenbrook, Delgany, Co. Wicklow, Ireland.
*Pewtrees, H. J. ..	Tillington, Hereford.
*Phayre, Lt.-Col. ..	Belgaum, Woking.
*Poupart, J. ..	Holly Farm, Walton-on-Thames, Surrey.
*Priestley, S. ..	Brackley, Carr Wood Road, Bramhall, Cheshire.

*Ravenhill, W.	..	Loseberry, Claygate, Surrey.
*Rietsema, Dr. J.	..	12, Teteringsche Dijh at Breda, Holland.
*Sawers, B. L.	..	Curtisden Green, Goudhurst, Kent.
*Scrutton, Miss M. E.	..	Bottrell's Cottage, Chalfont, St. Giles, Bucks.
*Smith, F.	..	Fant Farm, East Peckham, Paddock Wood, Kent.
*Sowrey, J.	..	Yeoveney Lodge Farm, Staines, Middlesex.
*Starkey, J. R.	..	Norwood Park, Southwell, Notts.
*Steynor, R. L.	..	Dyke House Fruit Farm, Dymock, Gloucester.
*Tapsfield, W.	..	Whetstead, Five Oak Green, near Tonbridge, Kent.
*Tayler & Sons	..	Bell Farm, Barming, Maidstone, Kent.
*Trechmann, N. G.	..	Pikelands, Harvington, Evesham, Worcester.
*Wallace, W. E.	..	The Nurseries, Eaton Bray, Dunstable, Bedford.
*Warnock, J. & Sons	..	Garrion Farm, Wishaw.
Western, Captain F.	..	Scraces, Barming, Maidstone, Kent.
*Whitehead, J. A.	..	12, Heath Drive, Potters Bar, Middlesex.
*White & Hiller, Messrs.		Dunnington Heath Farm, Alcester, Warwick.
*Willis, Captain G. H. A.		4, Lyndhurst Road, Hampstead, N.W.3.
*Wimshurst, T. E.	..	Tibbs' Court, Brenchley, Kent.
*Youngman, W. H.	..	Charsfield, Woodbridge, Suffolk.
*Youatt, Dr. L.	..	Applegold, Little Leighs, near Chelmsford, Essex.
*Youatt, Miss N.	..	Applegold, Little Leighs, near Chelmsford, Essex.

Donation to *Development Fund*, 1928.

Faversham Branch of National Farmers' Union.